

FUEL CELL STACK

Publication number: JP2001143741

Publication date: 2001-05-25

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Classification:

- international: *H01M8/24; H01M8/02; H01M8/24; H01M8/02; (IPC1-7):*
H01M8/24

- European:

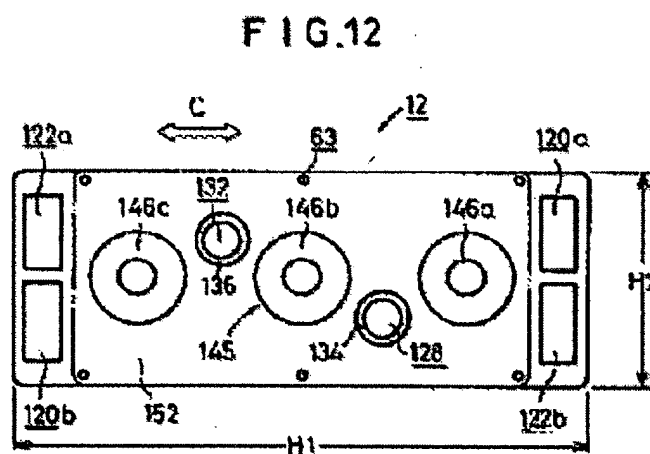
Application number: JP20000261260 20000830

Priority number(s): JP20000261260 20000830; JP19990249823 19990903

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Abstract of JP2001143741

PROBLEM TO BE SOLVED: To make the surface pressure within a fuel cell stack uniform as well as constituting the fuel cell stack long sideways. **SOLUTION:** A first fuel cell stack 12 is constituted long sideways and its transverse dimension H1 is set to more than two times its longitudinal dimension H2, for example, the ratio of the transverse dimension H1 to the longitudinal dimension 3:1. The pressurization means 145 comprises three dish spring 146a-146c disposed in a row into the transverse direction corresponding to the ratio of transverse to longitudinal of the fuel cell stack 12.



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(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号
特開2001-143741
(P2001-143741A)

(43) 公開日 平成13年5月25日 (2001.5.25)

(51) Int.Cl. ⁷	識別記号	F I	テマコード [*] (参考)
H 0 1 M	8/24	H 0 1 M	T 5 H 0 2 6
	8/02	8/02	P
			S
			Z

審査請求 未請求 請求項の数 8 O L (全 16 頁)

(21) 出願番号 特願2000-261260 (P2000-261260)
(22) 出願日 平成12年8月30日 (2000.8.30)
(31) 優先権主張番号 特願平11-249823
(32) 優先日 平成11年9月3日 (1999.9.3)
(33) 優先権主張国 日本 (J P)

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Fターム(参考) 5H026 AA06 CC03 CC08 CC10 CV06

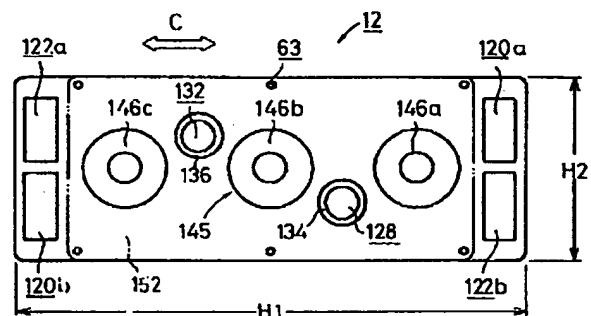
(54) 【発明の名称】 燃料電池スタック

(57) 【要約】

【課題】 横長形状の燃料電池スタックを構成するとともに、前記燃料電池スタック内の面圧分布を均一にすることを可能にする。

【解決手段】 第1燃料電池スタック12は、横長の長方形形状に構成されるとともに、横寸法H1が縦寸法H2の2倍以上、例えば、横寸法H1と縦寸法H2の比が略3:1に設定される。加圧手段145は、第1燃料電池スタック12の縦横比に対応して横方向に1列に配置される3個の皿ばね146a~146cを備える。

FIG.12



【特許請求の範囲】

【請求項1】固体高分子電解質膜をアノード側電極とカソード側電極とで挟んで構成される単位燃料電池セルが、セパレータを介して水平方向に複数個積層されるとともに、前記単位燃料電池セルの積層方向両端にエンドプレートが配設される燃料電池スタックであって、一方のエンドプレート側に設けられる面圧付与用液体封入部材と、

他方のエンドプレート側に設けられ、積層されている前記単位燃料電池セルを前記一方のエンドプレート側に押圧する加圧手段と、

を備え、

前記単位燃料電池セルは、横長の長方形状に構成されるとともに、横寸法が縦寸法の2倍以上に設定され、前記加圧手段は、横方向に1列に配置される n (n は2以上の整数)個の皿ばねを備えることを特徴とする燃料電池スタック。

【請求項2】請求項1記載の燃料電池スタックにおいて、前記単位燃料電池セルの横寸法と縦寸法の比が、略 $n:1$ に設定されることを特徴とする燃料電池スタック。

【請求項3】固体高分子電解質膜をアノード側電極とカソード側電極とで挟んで構成される単位燃料電池セルが、セパレータを介して水平方向に複数個積層されるとともに、前記単位燃料電池セルの積層方向両端にエンドプレートが配設される燃料電池スタックであって、一方のエンドプレート側に設けられる面圧付与用液体封入部材と、

他方のエンドプレート側に設けられ、積層されている前記単位燃料電池セルを前記一方のエンドプレート側に押圧する加圧手段と、

を備え、

前記単位燃料電池セルの発電面は、横長の長方形状に構成されるとともに、横寸法が縦寸法の2倍以上に設定され、

前記加圧手段は、横方向に1列に配置される n (n は2以上の整数)個の皿ばねを備えることを特徴とする燃料電池スタック。

【請求項4】請求項3記載の燃料電池スタックにおいて、前記発電面の横寸法と縦寸法の比が、略 $n:1$ に設定されることを特徴とする燃料電池スタック。

【請求項5】固体高分子電解質膜をアノード側電極とカソード側電極とで挟んで構成される単位燃料電池セルが、セパレータを介して水平方向に複数個積層されるとともに、前記単位燃料電池セルの積層方向両端にエンドプレートが配設される燃料電池スタックであって、一方のエンドプレート側に設けられる面圧付与部材と、他方のエンドプレート側に設けられ、積層されている前記単位燃料電池セルを前記一方のエンドプレート側に押圧する加圧手段と、

を備え、

前記単位燃料電池セルは、横長の長方形状に形成されるとともに、

前記加圧手段は、横方向に2列に配置される6個以上の皿ばねを備えることを特徴とする燃料電池スタック。

【請求項6】請求項5記載の燃料電池スタックにおいて、前記面圧付与部材は、前記皿ばねに対応して横方向に2列に配置される6個以上のワッシャプレートを備えることを特徴とする燃料電池スタック。

【請求項7】請求項5または6記載の燃料電池スタックにおいて、前記単位燃料電池セルの横寸法と縦寸法の比が、略3:2に設定されることを特徴とする燃料電池スタック。

【請求項8】請求項5乃至7のいずれか1項に記載の燃料電池スタックにおいて、前記エンドプレートを貫通して配置され、複数の前記単位燃料電池セルを積層方向に一体的に保持する締め付けボルトと、

前記締め付けボルトの頭部に係合する球面ワッシャと、を備えることを特徴とする燃料電池スタック。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、固体高分子電解質膜をアノード側電極とカソード側電極とで挟んで構成される単位燃料電池セルが、セパレータを介して水平方向に複数個積層されるとともに、前記単位燃料電池セルの積層方向両端にエンドプレートが配設された燃料電池スタックに関する。

【0002】

【従来の技術】例えば、固体高分子型燃料電池は、高分子イオン交換膜(陽イオン交換膜)からなる電解質膜の両側にそれぞれアノード側電極およびカソード側電極を対設して構成された単位燃料電池セルを、セパレータによって挟持することにより構成されている。この固体高分子型燃料電池は、通常、単位燃料電池セルおよびセパレータを所定数だけ積層することにより、燃料電池スタックとして使用されている。

【0003】この種の燃料電池スタックにおいて、アノード側電極に供給された燃料ガス、例えば、水素含有ガスは、触媒電極上で水素イオン化され、適度に加湿された電解質膜を介してカソード側電極側へと移動する。その間に生じた電子が外部回路に取り出され、直流の電気エネルギーとして利用される。カソード側電極には、酸化剤ガス、例えば、酸素含有ガスあるいは空気が供給されているために、このカソード側電極において、前記水素イオン、前記電子および酸素ガスが反応して水が生成される。

【0004】ところで、燃料電池スタック内の接触抵抗が増大すると、内部抵抗損失が増大して端子電圧が低下してしまう。このため、接触抵抗を低減させるべく電極面(発電面)に付与される面圧が均一になるように、積

層されている各単位燃料電池セルに所望の締め付け力を付与する必要がある。

【0005】そこで、例えば、米国特許第5,484,666号公報に開示されているように、燃料電池スタックの両端に配置されているエンドプレート的一方に、上下方向および水平方向に2個ずつ合計4つの凹部を形成し、この凹部に皿ばねを配置するとともに、前記皿ばね内には、両エンドプレート間にわたってタイロッドを挿通して前記タイロッドの端部にナットを螺合することにより、前記燃料電池スタック全体を締め付け固定するように構成された燃料電池スタックが知られている。

【0006】

【発明が解決しようとする課題】しかしながら、上記の従来技術では、エンドプレートに上下および左右にそれぞれ2個ずつ凹部を形成して皿ばねを配置しているため、燃料電池スタック全体としてその高さ方向の寸法が、横方向の寸法と同等あるいはそれ以上の大きさとなっている。このため、特に、燃料電池スタックを車両等に搭載しようとする場合、この燃料電池スタックを収容し得る場所が相当に限定されてしまう。

【0007】しかも、上記の従来技術では、エンドプレートに4個の皿ばねを配置するだけである。これにより、皿ばねを介して単位燃料電池セルの発電面全面に均一な面圧を付与することができないおそれがある。

【0008】本発明はこの種の問題を解決するものであり、燃料電池スタック全体の高さ方向の寸法を有効に短尺化するとともに、積層される単位燃料電池セル全体に均一な締め付け力を付与することが可能な燃料電池スタックを提供することを目的とする。

【0009】

【課題を解決するための手段】本発明の請求項1に係る燃料電池スタックでは、単位燃料電池セルが水平方向に複数個積層されるとともに、この単位燃料電池セルが横長の長方形に構成され、その横寸法がその縦寸法の2倍以上に設定されている。このため、燃料電池スタック全体の高さ方向の寸法が有効に短尺化され、例えば、車両等に搭載する際に、前記燃料電池スタックの上部側のスペースを有効に活用することができるとともに、該燃料電池スタックを自動車車体の床下等に容易に収容することが可能になる。

【0010】さらに、燃料電池スタックの一方のエンドプレート側に面圧付与用液体封入部材が設けられるとともに、他方のエンドプレート側に横方向に1列に配置される2個以上の皿ばねを備えた加圧手段が配置される。これにより、加圧手段の押圧作用下、積層されている単位燃料電池セル全体に均一な面圧が確実に付与される。しかも、2個以上の皿ばねが1列に配置されており、単位燃料電池セルの形状に沿って皿ばねを均等に配置することができ、前記単位燃料電池セルに対して好適かつ強固に締め付け力を付与することが可能になる。

【0011】また、請求項2に係る燃料電池スタックでは、単位燃料電池セルの横寸法と縦寸法の比が略 $n:1$ の整数比に設定されている。このため、燃料電池スタック全体の高さを一層低くするとともに、複数の皿ばねを単位燃料電池セル全面に対して均等に配置することができ、前記単位燃料電池セル全面に付与される面圧を一層高精度に均一化することが可能になる。

【0012】さらに、請求項3に係る燃料電池スタックでは、単位燃料電池セルが水平方向に複数個積層されるとともに、この単位燃料電池セルの発電面が横長の長方形に構成され、その横寸法がその縦寸法の2倍以上に設定されている。従って、積層されている単位燃料電池セルの各発電面全体に対し、均一な面圧を確実に付与することができる。

【0013】さらにまた、請求項4に係る燃料電池スタックでは、単位燃料電池セルの発電面の横寸法と縦寸法の比が略 $n:1$ の整数比に設定されている。これにより、複数の皿ばねを発電面全面に対して均等に配置することができ、前記発電面全面に付与される面圧を一層高精度に均一化することが可能になる。

【0014】また、請求項5に係る燃料電池スタックでは、単位燃料電池セルが横長の長方形に形成されるとともに、一方のエンドプレート側には面圧付与部材が設けられ、他方のエンドプレート側には横方向に2列に配置される6個以上の皿ばねを備える加圧手段が配置されている。このため、単位燃料電池セル全体に均一な面圧を付与するとともに、組み立て時に倒れ等が惹起することがなく、燃料電池スタックの組み立て作業が高精度かつ効率的に遂行される。

【0015】さらに、請求項6に係る燃料電池スタックでは、面圧付与部材が皿ばねに対応して横方向に2列に配置される6個以上のワッシャプレートを用意している。従って、構成が簡素化して経済的なものとなり、しかも各皿ばねと各ワッシャプレートとが互に対向して配置されるため、モーメント荷重が付与されることを確実に防止して、燃料電池スタック全体を強固かつ確実に締め付けることが可能になる。その上、ワッシャプレートを用いることにより、厚さ方向である単位燃料電池セルの積層方向の寸法が薄肉化され、燃料電池スタック全体の積層方向を有効に短尺化することができる。

【0016】さらにまた、請求項7に係る燃料電池スタックでは、単位燃料電池セルの横寸法と縦寸法の比が、略 $3:2$ に設定されている。このため、特に、横方向に2列ずつ、合計6個以上の皿ばねを単位燃料電池セル全面に対して均等に配置することができ、前記単位燃料電池セル全面に高精度かつ均一に面圧を付与することが可能になる。

【0017】また、請求項8に係る燃料電池スタックでは、単位燃料電池セルを積層方向に一体的に保持する締め付けボルトと、前記締め付けボルトの頭部に係合する

球面ワッシャとを備えている。これにより、燃料電池スタック全体を積層方向に加圧保持する際に、締め付けボルトを支持するエンドプレートやバックアッププレートが変形しても、球面ワッシャの作用下に燃料電池スタックに対して積層方向の締め付け力を確実に付与することができる。

【0018】

【発明の実施の形態】図1は、本発明の第1の実施形態に係る燃料電池スタックを組み込む燃料電池システム10の概略斜視説明図であり、図2は、前記燃料電池システム10の側面説明図である。

【0019】燃料電池システム10は、水平方向（矢印A方向）に沿って互いに平行に配列される第1燃料電池スタック12と第2燃料電池スタック14とを備える。第1および第2燃料電池スタック12、14の同一側の一端部鉛直面を構成する第1エンドプレート16、18には、正極である第1電力取り出し端子20および負極である第2電力取り出し端子22が設けられる。

【0020】第1および第2燃料電池スタック12、14の同一側の他端部鉛直面である第2エンドプレート24、26側には、前記第1および第2燃料電池スタック12、14に対して燃料ガス、酸化剤ガスおよび冷却媒体の供給と排出を行うための配管機構28が組み込まれる。第1および第2燃料電池スタック12、14は、取り付け機構30を介して車両を構成する取り付けプレート31に固定される。

【0021】第1燃料電池スタック12は、図3および図4に示すように、単位燃料電池セル32と、この単位燃料電池セル32を挟持する第1および第2セパレータ34、36とを備え、これらが複数組だけ水平方向（矢印A方向）に積層されている。第1燃料電池スタック12は、全体として直方体状を有しており、短辺方向（矢印B方向）が重力方向に指向するとともに、長辺方向（矢印C方向）が水平方向に指向して配置される。

【0022】単位燃料電池セル32は、固体高分子電解質膜38と、この電解質膜38を挟んで配設されるカソード側電極40およびアノード側電極42とを有するとともに、前記カソード側電極40および前記アノード側電極42には、例えば、多孔質層である多孔質カーボンペーパー等からなる第1および第2ガス拡散層44、46が配設される。

【0023】単位燃料電池セル32の両側には、第1および第2ガasket48、50が設けられ、前記第1ガasket48は、カソード側電極40および第1ガス拡散層44を収納するための大きな開口部52を有する一方、前記第2ガasket50は、アノード側電極42および第2ガス拡散層46を収納するための大きな開口部54を有する。単位燃料電池セル32と第1および第2ガasket48、50とが、第1および第2セパレータ34、36によって挟持される。

【0024】第1セパレータ34は、カソード側電極40に対向する面34aおよび反対側の面34bが長方形状に設定されており、例えば、長辺55aが水平方向に指向するとともに、短辺55bが重力方向に指向して配置される。

【0025】第1セパレータ34の短辺55b側の両端縁部上部側には、酸素ガスまたは空気である酸化剤ガスを通過させるための酸化剤ガス入口56aと、水素ガス等の燃料ガスを通過させるための燃料ガス入口58aとが、上下方向に長尺な長方形状を有して設けられる。第1セパレータ34の短辺55b側の両端縁部下部側には、酸化剤ガス出口56bと燃料ガス出口58bとが、酸化剤ガス入口56aおよび燃料ガス入口58aと対角位置になるようにかつ上下方向に長尺な長方形状を有して設けられている。

【0026】第1セパレータ34の長辺55aの下端部には、矢印C方向に長尺な4つの冷却媒体入口60a～60dが設けられるとともに、この第1セパレータ34の長辺55a側の上部には、同様に、矢印C方向に長尺な4つの冷却媒体出口60e～60hが設けられる。冷却媒体入口60a～60dには、純水やエチレングリコールやオイル等の冷却媒体が供給される。

【0027】第1セパレータ34の面34aには、酸化剤ガス入口56aに連通する10本のそれぞれ独立した第1酸化剤ガス流路溝62が、水平方向に蛇行しながら重力方向に向かって設けられる。第1酸化剤ガス流路溝62は、5本の第2酸化剤ガス流路溝65に合流し、前記第2酸化剤ガス流路溝65が酸化剤ガス出口56bに連通する。第1セパレータ34には、タイロッド挿通用の孔部63が6箇所に形成されている。

【0028】第2セパレータ36は長方形状に形成されており、この第2セパレータ36の短辺64b側の両端縁部上部側には、酸化剤ガス入口66aおよび燃料ガス入口68aが貫通形成されるとともに、その両端縁部下部側には、酸化剤ガス出口66bおよび燃料ガス出口68bが、前記酸化剤ガス入口66aおよび前記燃料ガス入口68aと対角位置になるように貫通形成されている。

【0029】第2セパレータ36の長辺64a側の下部には、矢印C方向に長尺な4つの冷却媒体入口70a～70dが貫通形成され、この長辺64a側の上部には、冷却媒体出口70e～70hが、同様に、矢印C方向に長尺に貫通形成される。

【0030】図5に示すように、第2セパレータ36の面36aには、燃料ガス入口68aに連通して10本の第1燃料ガス流路溝72が形成される。この第1燃料ガス流路溝72が、水平方向に蛇行しながら重力方向に向かって設けられ、5本の第2燃料ガス流路溝73に合流し、前記第2燃料ガス流路溝73が燃料ガス出口68bに連通する。

【0031】図6に示すように、第2セパレータ36の面36aとは反対側の面36bには、冷却媒体入口70a~70dと冷却媒体出口70e~70hにそれぞれ個別に連通する冷却媒体流路74a~74dが重力方向に向かって設けられる。冷却媒体流路74a~74dは、冷却媒体入口70a~70dと冷却媒体出口70e~70hに連通するそれぞれ9本の第1流路溝76a、76bを備えるとともに、前記第1流路溝76a、76b間には、それぞれ2本の第2流路溝78が互いに重力方向に平行しかつ所定間隔ずつ離間して設けられる。第2セパレータ36には、第1セパレータ34と同様に、タイロッド挿通用の孔部63が6箇所に設けられている。

【0032】図7に示すように、所定数だけ積層された単位燃料電池セル32の積層方向両端には、ターミナルプレートである端子板80と第1導電プレート82とが配設される。端子板80には、絶縁板84を介して第1エンドプレート16が積層されるとともに、この端子板80に第1電力取り出し端子20が装着される。

【0033】図8に示すように、第1電力取り出し端子20は、円柱状の大径部86の両端に小径なねじ部88a、88bを設けている。このねじ部88aは、端子板80に形成された孔部90を通して第1セパレータ34の酸化剤ガス入口56a内に突出し、前記ねじ部88aにナット部材92が螺着される。大径部86の肩部には、端子板80との間のシール性を向上させるためにシール部材94が介装されるとともに、前記大径部86の外周と第1エンドプレート16に形成された孔部96との間に絶縁リング98が介装される。

【0034】図9に示すように、第1導電プレート82は、第2セパレータ36とほぼ同一形状、すなわち、長方形に設定されており、短辺側の両端縁部には、酸化剤ガス入口100a、燃料ガス入口102aおよび酸化剤ガス出口100b、燃料ガス出口102bが互いに対角位置に設けられている。第1導電プレート82の長辺側下部および上部には、それぞれ4つの冷却媒体入口104a~104dと冷却媒体出口104e~104hが設けられるとともに、タイロッド挿通用の孔部63が6箇所に形成されている。

【0035】第1導電プレート82には、第1燃料電池スタック12の下側にかつ第2燃料電池スタック14に近接して延在する第1接続板部106が設けられる。第1接続板部106には、下方に突出して2本のボルト部108a、108bが設けられ、このボルト部108a、108bおよび第1導電プレート82は、導電性を有する材料、例えば、SUSや銅等で構成されている。図7に示すように、第1導電プレート82には、絶縁板110、蓋板112およびシール部材114を介して第2エンドプレート24が積層される。

【0036】図10および図11に示すように、第2エンドプレート24は長方形に構成されており、その短

辺側の両端縁部上部側には、酸化剤ガス入口120aと燃料ガス入口122aとが貫通形成されるとともに、その短辺側の両端縁部下部側には、酸化剤ガス出口120bと燃料ガス出口122bとが前記酸化剤ガス入口120aおよび前記燃料ガス入口122aと対角位置になるように設けられる。

【0037】第2エンドプレート24の内側の面24aには、第2セパレータ36の冷却媒体入口70a~70dに連通する第1冷却媒体流路溝124a~124dと、前記第2セパレータ36の冷却媒体出口70e~70hに連通する第2冷却媒体流路溝124e~124hが、水平方向に長尺でかつ所定の深さを有して形成される。第1冷却媒体流路溝124a~124dは、それぞれ12本の第1溝部126aの端部に連通する。第1溝部126aは、互いに平行に上方に延在した後、それぞれ2本ずつ合流して第2溝部126bが設けられ、前記第2溝部126bがそれぞれ2本ずつ第3溝部126cに合流して単一の冷却媒体供給口128に連通する。

【0038】第2冷却媒体流路溝124e~124hは、同様に、それぞれ12本の第1溝部130aに連通し、前記第1溝部130aが鉛直下方向に延在して第2溝部130bに2本ずつ合流する。第2溝部130bは、2本ずつ第3溝部130cに合流して単一の冷却媒体排出口132に連通する。冷却媒体供給口128および冷却媒体排出口132には、図10に示すように、供給管路134と排出管路136が連結されており、この供給管路134およびこの排出管路136が、第1燃料電池スタック12の外方に所定の長さだけ突出している。第2エンドプレート24には、タイロッド挿通用の孔部63が6箇所に形成されている(図11参照)。

【0039】図7に示すように、第1燃料電池スタック12は、締め付け機構140を介して積層方向(矢印A方向)に一体的に締め付け固定される。締め付け機構140は、第1エンドプレート16の外面側に設けられる液体チャンバ142と、この液体チャンバ142内に封入される非圧縮性の面圧付与用液体、例えば、シリコンオイル144と、加圧手段145とを備える。この加圧手段145は、第2エンドプレート24の外面側に設けられ、前記第2エンドプレート24を第1エンドプレート16側に押圧するために水平方向に所定間隔ずつ離間して1列に配置される2つ以上、例えば、3つの皿ばね146a~146cを備える。

【0040】液体チャンバ142を挟んで第1エンドプレート16に対向してバックアッププレート148が配設され、このバックアッププレート148とアルミニウムまたはステンレススチールの薄板150とにより液体チャンバ142を設けた面圧付与用液体封入部材が構成される。皿ばね146a~146cは、第2エンドプレート24の面内に略等間隔ずつ離間して配置されるとともに、取り付け板152により支持される。取り付け板

152から第1燃料電池スタック12を貫通してバックアッププレート148に6本のタイロッド154が挿入される。タイロッド154の端部にナット156がねじ込まれることにより、第1燃料電池スタック12が一体的に保持される。

【0041】図12に示すように、第1燃料電池スタック12（すなわち、単位燃料電池セル32）は、横長の長方形に構成されるとともに、横寸法H1が縦寸法H2の2倍以上に設定されている。

【0042】第1の実施形態では、横寸法H1と縦寸法H2の比が略n（nは2以上の整数）：1、例えば、略3：1の整数比に設定されている。各単位燃料電池セル32の全面に均一な面圧を付与するために、第1燃料電池スタック12には、横寸法H1と縦寸法H2の比に対応して3個の皿ばね146a～146cが等間隔ずつ離間して水平方向（矢印C方向）に配置されている。換言すれば、単位燃料電池セル32の横寸法H1と縦寸法H2の比が整数比に設定されることにより、その比に対応する数の皿ばね146a～146cを単位燃料電池セル32の全面に対して均等に配置することができる。

【0043】図2および図13に示すように、取り付け機構30は、第1エンドプレート16の下部側に一体的に設けられるブラケット部160a、160bと、第2エンドプレート24の下部側にねじ止めされるマウントブラケット162a、162bとを備える。ブラケット部160a、160bには、第1燃料電池スタック12の積層方向（矢印A方向）に長尺な長孔164a、164bが形成される一方、マウントブラケット162a、162bに孔部166a、166bが形成される。

【0044】長孔164a、164bおよび孔部166a、166bには、それぞれゴムマウント168が配置される。ゴムマウント168は、上下にねじ部170a、170bが設けられており、上部に突出する前記ねじ部170aにカラー172が配置されてこのカラー172がここから長孔164a、164bに挿入されるとともに、該ねじ部170aにナット174が螺合される。マウントブラケット162a、162b側では、ゴムマウント168のねじ部170aが孔部166a、166bに挿入されてその先端部にナット174が螺合される。ゴムマウント168の下部側に突出するねじ部170bは、取り付けプレート31に挿入されてナット176が螺合されることにより、第1燃料電池スタック12を車両等に固定する。

【0045】図14に示すように、第2燃料電池スタック14は、上述した第1燃料電池スタック12とは対称的に構成されるとともに、電解質膜38に対してカソード側電極40とアノード側電極42とが逆側に配置されており、第1エンドプレート18側に負極である第2電力取り出し端子22が設けられる（図15参照）。第2燃料電池スタック14は、基本的には第1燃料電池スタ

ック12と同様に構成されており、同一の構成要素には同一の参照符号を付してその詳細な説明を省略する。

【0046】図16に示すように、第2燃料電池スタック14は、第2導電プレート180を備えており、この第2導電プレート180には、前記第2燃料電池スタック14の下側に延在しかつ第1燃料電池スタック12に設けられている第1導電プレート82の第1接続板部106に近接する第2接続板部182を設けている。第1および第2接続板部106、182には、それぞれ一对のボルト部108a、108bと184a、184bとが設けられている。

【0047】ボルト部108aと184aおよびボルト部108bと184bには、それぞれ可撓性接続体、例えば、燃り線186a、186bが接続される。燃り線186a、186bは、多数の細線状の導線を網状に燃ることにより構成されており、それぞれゴムカバー188a、188bにより覆われている。

【0048】図14に示すように、第1および第2燃料電池スタック12、14を構成する第2エンドプレート24、26には、それぞれ燃料ガス入口122aと酸化剤ガス出口120bとが互いに近接する位置に配置されており、この第2エンドプレート24、26に配管機構28が組み込まれる。

【0049】図1および図17に示すように、配管機構28は、互いに並設される第1および第2燃料電池スタック12、14を構成する第2エンドプレート24、26の各燃料ガス入口122aを覆って前記第2エンドプレート24、26に一体的に固定される第1ブラケット190を備える。この第1ブラケット190には、各燃料ガス入口122aにそれぞれ連通する燃料ガス供給管192a、192bが設けられ、前記燃料ガス供給管192a、192bが合流して燃料ガス供給口194に連通する。

【0050】第2エンドプレート24、26には、各酸化剤ガス出口120bを覆って第2ブラケット196が固定される。この第2ブラケット196に設けられ酸化剤ガス出口120bにそれぞれ連通する酸化剤ガス排出管198a、198bの先端部が、酸化剤ガス排出口200に一体的に連通する。

【0051】第2エンドプレート24、26には、それぞれの酸化剤ガス入口120aおよび燃料ガス出口122bを覆って第3および第4ブラケット202、204が固定される。第3および第4ブラケット202、204には、酸化剤ガス入口120aに連通する酸化剤ガス供給管206の両端が連通するとともに、この酸化剤ガス供給管206の途上に酸化剤ガス供給口208が設けられる。第3および第4ブラケット202、204には、燃料ガス出口122bに連通する燃料ガス排出管210の両端が連通し、この燃料ガス排出管210の途上に燃料ガス排出口212が設けられる。

【0052】第2エンドプレート24、26に設けられている各供給管路134に冷却媒体供給管214の両端が連結され、この冷却媒体供給管214に冷却媒体供給口216が設けられる。第2エンドプレート24、26に設けられている各排出管路136に冷却媒体排出管218が連結されるとともに、この冷却媒体排出管218に冷却媒体排出口220が設けられる。

【0053】このように構成される燃料電池システム10の動作について、以下に説明する。

【0054】図1に示すように、燃料電池システム10には、燃料ガス供給口194から燃料ガス（例えば、炭化水素を改質した水素を含むガス）が供給されるとともに、酸化剤ガス供給口208に酸化剤ガスとして空気または酸素ガス（以下、単に空気ともいう）が供給される。さらに、冷却媒体供給口216に冷却媒体が供給される。

【0055】燃料ガス供給口194に供給された燃料ガスは、燃料ガス供給管192a、192bを通して第1および第2燃料電池スタック12、14を構成する第2エンドプレート24、26の各燃料ガス入口122aに送られ、さらに第2セパレータ36の各燃料ガス入口68aから第1燃料ガス流路溝72に導入される。図5に示すように、第1燃料ガス流路溝72に供給された燃料ガスは、第2セパレータ36の面36aに沿って水平方向に蛇行しながら重力方向に移動する。

【0056】その際、燃料ガス中の水素ガスは、第2ガス拡散層46を通して単位燃料電池セル32のアノード側電極42に供給される。そして、未使用の燃料ガスは、第1燃料ガス流路溝72に沿って移動しながらアノード側電極42に供給される一方、未使用の燃料ガスが第2燃料ガス流路溝73を介して燃料ガス出口68bから排出される。この未使用の燃料ガスは、第2エンドプレート24、26の各燃料ガス出口122bを通して燃料ガス排出管210に導入され、燃料ガス排出口212を介して燃料電池システム10から排出される。

【0057】一方、酸化剤ガス供給口208に供給された空気は、酸化剤ガス供給管206を介して第2エンドプレート24、26に設けられた各酸化剤ガス入口120aに送られ、さらに第1および第2燃料電池スタック12、14内に組み込まれた第1セパレータ34の酸化剤ガス入口56aに供給される（図3参照）。第1セパレータ34では、酸化剤ガス入口56aに供給された空気が面34a内の第1酸化剤ガス流路溝62に導入され、この第1酸化剤ガス流路溝62に沿って水平方向に蛇行しながら重力方向に移動する。

【0058】その際、空気中の酸素ガスは、第1ガス拡散層44からカソード側電極40に供給される一方、未使用の空気が第2酸化剤ガス流路溝65を介して酸化剤ガス出口56bから排出される。この酸化剤ガス出口56bに排出された空気は、第2エンドプレート24、2

6に設けられた酸化剤ガス出口120bから酸化剤ガス排出管198a、198bを介して酸化剤ガス排出口200より排出される（図1参照）。

【0059】これにより、第1および第2燃料電池スタック12、14で発電が行われ、それぞれ特性の異なる第1および第2電力取り出し端子20、22間に接続される負荷、例えば、図示しないモータに電力が供給されることになる。

【0060】また、第1および第2燃料電池スタック12、14内は、冷却媒体により有効に冷却される。すなわち、冷却媒体供給口216に供給された冷却媒体は、冷却媒体供給管214から第2エンドプレート24、26に設けられている供給管路134に導入される。この冷却媒体は、図11に示すように、第2エンドプレート24、26の冷却媒体供給口128に導入され、複数の第2溝部126bから第1溝部126aを通して第1冷却媒体流路溝124a～124dに送られる。

【0061】第1冷却媒体流路溝124a～124dに導入された冷却媒体は、第2セパレータ36の下部側に形成された冷却媒体入口70a～70dに導入され、図6に示すように、前記冷却媒体入口70a～70dに連通する冷却媒体流路74a～74dに沿って下方から上方に向かって移動する。冷却媒体流路74a～74dを通して各単位燃料電池セル32を冷却した冷却媒体は、冷却媒体出口70e～70hを通して第2エンドプレート24、26の第2冷却媒体流路溝124e～124hに導入される（図11参照）。

【0062】この第2冷却媒体流路溝124e～124hに導入された冷却媒体は、第1溝部130aから第2溝部130bを介して冷却媒体排出口132に送られ、排出管路136から冷却媒体排出管218を通して冷却媒体排出口220より排出される。

【0063】この場合、第1の実施形態では、図12に示すように、第1燃料電池スタック12（すなわち、単位燃料電池セル32）の横寸法H1と縦寸法H2との比が、略3：1に設定されている。そして、第1燃料電池スタック12に対して積層方向に面圧を付与するために締め付け機構140が、第1エンドプレート16の外面側に設けられる液体チャンバ142と、第2エンドプレート24の外面側に設けられ、第1燃料電池スタック12の縦横比に対応して横方向に1列に配置される3つの皿ばね146a～146cとを備えている。

【0064】このように、第1の実施形態では、単位燃料電池セル32の縦横比に対応して皿ばね146a～146cが設定されるため、第1燃料電池スタック12内の面圧分布が均一になる。これにより、発電性能を有効に向上させるとともに、燃料ガスや酸化剤ガスの漏れを阻止して、有効なシール性を確保することができるという効果が得られる。

【0065】しかも、単位燃料電池セル32の横寸法H

1と縦寸法H2の比が整数比、例えば、略3:1に設定されている。従って、その整数比に対応する数の皿ばね164a~164cを使用すれば、前記皿ばね164a~164cを単位燃料電池セル32の全面に対して均等に配置することができる。これにより、特に、単位燃料電池セル32の両端部に設けられた酸化剤ガス入口56aおよび酸化剤ガス出口56bを含む酸化剤ガス連通路や、燃料ガス入口68aおよび燃料ガス出口68bを含む燃料ガス連通路の周囲に均一な締め付け力を付与することが可能になり、酸化剤ガスおよび燃料ガスのシール性を高精度に維持することができるという利点がある。

【0066】さらに、第1燃料電池スタック12を横長に構成することができ、前記第1燃料電池スタック12の高さ方向の寸法を相当に低く設定することが可能になる。従って、燃料電池システム10は、所望の起電力を有して高さ方向の寸法を大幅に削減することができ、特に、車載用燃料電池システム10として効果的に使用することが可能になるという利点がある。

【0067】また、第2セパレータ36では、一方の面36aに第1および第2燃料ガス流路溝72、73が水平方向に蛇行しながら重力方向に向かって設けられるとともに、前記第2セパレータ36の面36bには、冷却媒体流路74a~74dを構成する第1流路溝76a、76bおよび第2流路溝78が重力方向に向かって設けられている。

【0068】このように、第2セパレータ36では、第1および第2燃料ガス流路溝72、73と、第1および第2流路溝76a、76bおよび78とが、互いに直交するように設けられており、前記第2セパレータ36自体の曲げ剛性が有効に向上する。これにより、第2セパレータ36の厚さを有効に薄肉化することが可能になり、第1燃料電池スタック12全体の積層方向の寸法を容易に短尺化することが可能になる。

【0069】なお、第1の実施形態では、第1および第2燃料電池スタック12、14を積層方向に並列させた燃料電池システム10を用いて説明したが、第1燃料電池スタック12のみを使用する場合にも同様の効果が得られる。

【0070】図18は、本発明の第2の実施形態に係る燃料電池スタック240の正面説明図である。なお、第1の実施形態に係る第1燃料電池スタック12と同一の構成要素には同一の参照符号を付して、その詳細な説明を省略する。また、以下に説明する第3の実施形態に係る燃料電池スタック260においても同様である。

【0071】この燃料電池スタック240では、単位燃料電池セル32の発電面を構成するカソード側電極40およびアノード側電極42が横長の長方形を有しており、その横寸法H3がその縦寸法H4の2倍以上に設定されている。第2の実施形態では、横寸法H3と縦寸法H4の比が略n (nは2以上の整数):1、例えば、略

3:1の整数比に設定されている。

【0072】燃料電池スタック240には、発電面の横寸法H3と縦寸法H4の比に対応して、3つの皿ばね146a~146cが等間隔ずつ離間して水平方向(矢印C方向)に配置されている。すなわち、単位燃料電池セル32の発電面の横寸法H3と縦寸法H4の比が整数比に設定されることにより、その比に対応する数の皿ばね146a~146cを発電面全面に対して均等に配置することができる。

【0073】これにより、第2の実施形態では、燃料電池スタック240内の発電面全面に均一な締め付け力を付与することが可能になり、発電性能を有効に向上させることができるという効果が得られる。

【0074】図19は、本発明の第3の実施形態に係る燃料電池スタック260の概略斜視説明図であり、図20は、前記燃料電池スタック260の概略縦断面説明図である。

【0075】燃料電池スタック260は、締め付け機構262を介して積層方向に一体的に締め付け固定される。この締め付け機構262は、第1エンドプレート16とバックアッププレート148との間に配置される面圧付与部材である6個以上、例えば、6個のワッシャプレート264a~264fと、第2エンドプレート24の外側面に設けられる加圧手段266とを備える。

【0076】ワッシャプレート264a~264fは、第1エンドプレート16に接する側に平坦面276を設ける一方、バックアッププレート148に接触する側に球面あるいは円弧面である湾曲面278が設けられており、全体として略円盤状に設定されている。ワッシャプレート264a~264fは、第1エンドプレート16側に対して水平方向に所定間隔ずつ離間して上下2列に配置されている。

【0077】加圧手段266は、第2エンドプレート24の外側面に設けられ、この第2エンドプレート24を第1エンドプレート16側に押圧するために、水平方向に所定間隔ずつ離間して上下2列に配置される6個以上、例えば、6個の皿ばね268a~268fを備える。皿ばね268a~268cは、第2エンドプレート24の上部側に水平方向に向かって配置され、かつワッシャプレート264a~264cと矢印A方向に略一致する位置に設定されている。皿ばね268d~268fは、第2エンドプレート24の下部側にかつワッシャプレート264d~264fと矢印A方向に略一致する位置に対応して配置されている。

【0078】バックアッププレート148から燃料電池スタック260を貫通して取り付け板152に6本のタイロッド(締め付けボルト)270が挿入される。図20に示すように、タイロッド270の端部にナット272がねじ込まれるとともに、前記タイロッド270の頭部270aとバックアッププレート148との間には、

球面ワッシャ274が介装される。

【0079】図21に示すように、燃料電池スタック260は、横長の長方形形状に形成されるとともに、横寸法H5と縦寸法H6との比が、略3:2に設定されている。

【0080】このように構成される第3の実施形態では、第2エンドプレート24の面内に、上下2列でかつ水平方向に等間隔ずつ離間して6個の皿ばね268a~268fが水平方向(矢印A方向)に2列に配置されている。このため、特に、燃料電池スタック260を組み付ける際に取り付け板152が倒れることがなく、前記燃料電池スタック260を、簡単な作業で効率的に組み付けることができるという効果が得られる。

【0081】さらに、燃料電池スタック260では、横寸法H5と縦寸法H6の比が、略3:2に設定されている。従って、第2エンドプレート24の全面に対して6個の皿ばね268a~268fを、上下方向かつ水平方向に均等に配置することが可能になり、燃料電池スタック260全体を面圧分布が均一になるように確実に締め付け保持することができ、有効なシール性を確保することが可能になる。

【0082】さらにまた、この第3の実施形態では、第1エンドプレート16の外側面に、6個のワッシャプレート264a~264fが面圧付与部材として配置されている。これにより、構成が有効に簡素化されて極めて経済的なものになるとともに、厚さ方向の寸法が削減され、燃料電池スタック260全体の積層方向の短尺化が容易に図られる。

【0083】その際、皿ばね268a~268fの中心とワッシャプレート264a~264fの中心とは、矢印A方向にそれぞれ略一致するようにして配置されている。このため、皿ばね268a~268fを介して燃料電池スタック260に締め付け力が付与される際、モーメント荷重が発生することを有効に阻止することができ、前記燃料電池スタック260に曲がり等が発生することを防止し得るという効果がある。

【0084】また、タイロッド270の頭部270aに係合して球面ワッシャ274が設けられている。従って、図22に示すように、燃料電池スタック260の加圧時にバックアッププレート148が湾曲する際、球面ワッシャ274がこのバックアッププレート148の変形を有効に吸収し、タイロッド270を介して前記燃料電池スタック260を矢印A方向に確実に締め付け固定することができる。

【0085】ここで、ワッシャプレート264a~264fは、平坦面276が第1エンドプレート16に接触する一方、湾曲面278がバックアッププレート148の変形時にも、前記バックアッププレート148に面接触している。このため、燃料電池スタック260全体の締め付け状態を有効に維持することが可能になる。

【0086】図23は、本発明の第4の実施形態に係る燃料電池スタック300の一部断面説明図である。

【0087】この燃料電池スタック300を構成する第1エンドプレート302の外側面には、面圧付与部材である平板状のワッシャプレート304a~304fの一部を収容するための収容溝306が、上下2列でかつ水平方向に所定間隔ずつ離間して6箇所に設けられている。第1エンドプレート302に対向して配置されるバックアッププレート308には、収容溝306に対向してワッシャプレート304a~304fを部分的に収容する収容溝310が、上下2列でかつ水平方向に所定間隔ずつ離間して6箇所に設けられる。この収容溝310には、ワッシャプレート304a~304f側に突出する押圧部312が設けられている。

【0088】このように構成される燃料電池スタック300では、例えば、6個のワッシャプレート304a~304fが、第1エンドプレート302とバックアッププレート308とにそれぞれ形成された収容溝306、310に対応して配置される。これにより、ワッシャプレート304a~304fを所望の位置に容易かつ確実に組み込むことができ、燃料電池スタック300の組み付け作業性が有効に向上するという効果が得られる。

【0089】図24は、本発明の第5の実施形態に係る燃料電池スタック320の一部断面説明図である。

【0090】この燃料電池スタック320では、バックアッププレート322に収容溝310の中央部からワッシャプレート304a~304f側に膨出する球面状押圧部324が設けられている。その他の構成は第4の実施形態に係る燃料電池スタック300と同一であるため、その詳細な説明は省略する。

【0091】図25は、本発明の第6の実施形態に係る燃料電池スタック340の一部断面説明図である。

【0092】この燃料電池スタック340では、バックアッププレート342に第1エンドプレート302の収容溝306と同一形状の収容溝344が形成されている。この収容溝306、344には、ワッシャプレート264a~264fが収容されている。ワッシャプレート264a~264fは、平坦面276が第1エンドプレート302側に配置される一方、湾曲面278がバックアッププレート342側に対応して配置されている。その他の構成は第4の実施形態に係る燃料電池スタック300と同一であるため、その詳細な説明は省略する。

【0093】

【発明の効果】本発明に係る燃料電池スタックでは、単位燃料電池セルが横長形状に構成されるとともに、前記単位燃料電池セルを積層方向に加圧する加圧手段が、横方向に1列に配置されるn個の皿ばねを備えており、燃料電池スタックの高さ方向の寸法を有効に低くした状態で、単位燃料電池セル全面の面圧分布を均一にすることができる。これにより、発電性能を高く維持するとともに

に、シール性能に優れた横長形状の燃料電池スタックを確実に得ることが可能になる。

【0094】また、本発明に係る燃料電池スタックでは、単位燃料電池セルの発電面が横長形状に構成されるとともに、この発電面の形状に対応して n 個の皿ばねが横方向に 1 列に配置される。このため、発電面全面に均一な締め付け力を付与することができ、発電性能の向上を図ることが可能になる。

【0095】さらにまた、本発明に係る燃料電池スタックでは、単位燃料電池セルが横長形状に構成されるとともに、面圧付与部材に対向して配置されている加圧手段が、横方向に 2 列に配置される 6 個以上の皿ばねを備えている。従って、燃料電池スタックの組み付け作業性が向上するとともに、単位燃料電池セル全面の面圧分布を均一にすることが可能になる。

【図面の簡単な説明】

【図 1】本発明の第 1 の実施形態に係る燃料電池スタックを組み込む燃料電池システムの概略斜視説明図である。

【図 2】前記燃料電池システムの側面説明図である。

【図 3】前記燃料電池スタックの要部分解斜視図である。

【図 4】前記燃料電池スタックの要部縦断面説明図である。

【図 5】前記燃料電池スタックを構成する第 2 セパレータの一方の面の正面説明図である。

【図 6】前記第 2 セパレータの他方の面の正面説明図である。

【図 7】前記燃料電池スタックの概略縦断面説明図である。

【図 8】前記燃料電池スタックを構成する電力取り出し端子の接続構造を示す説明図である。

【図 9】前記燃料電池スタックを構成する導電プレートの斜視説明図である。

【図 10】前記燃料電池スタック内の流体の流れを示す流路説明図である。

【図 11】前記燃料電池スタックを構成する第 2 エンドプレートの内方側の面の正面説明図である。

【図 12】前記燃料電池スタックの正面説明図である。

【図 13】前記燃料電池スタックの平面説明図である。

【図 14】配管機構が省略された状態の前記燃料電池システムの正面説明図である。

【図 15】前記燃料電池システムの背面説明図である。

【図 16】前記燃料電池システムの下側を示す斜視説明図である。

【図 17】前記燃料電池システムの正面説明図である。

【図 18】本発明の第 2 の実施形態に係る燃料電池スタックの正面説明図である。

【図 19】本発明の第 3 の実施形態に係る燃料電池スタックの概略斜視説明図である。

【図 20】前記燃料電池スタックの概略縦断面説明図である。

【図 21】前記燃料電池スタックの正面説明図である。

【図 22】前記燃料電池スタックの加圧状態を示す一部断面説明図である。

【図 23】本発明の第 4 の実施形態に係る燃料電池スタックの一部断面説明図である。

【図 24】本発明の第 5 の実施形態に係る燃料電池スタックの一部断面説明図である。

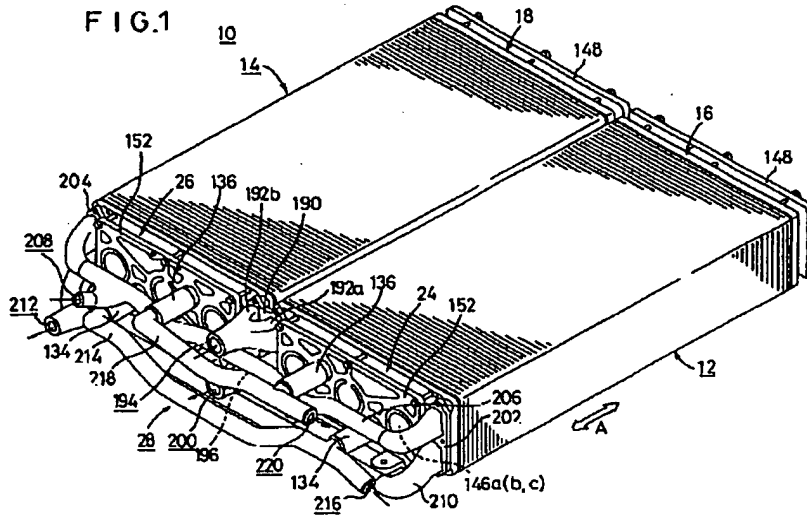
【図 25】本発明の第 6 の実施形態に係る燃料電池スタックの一部断面説明図である。

【符号の説明】

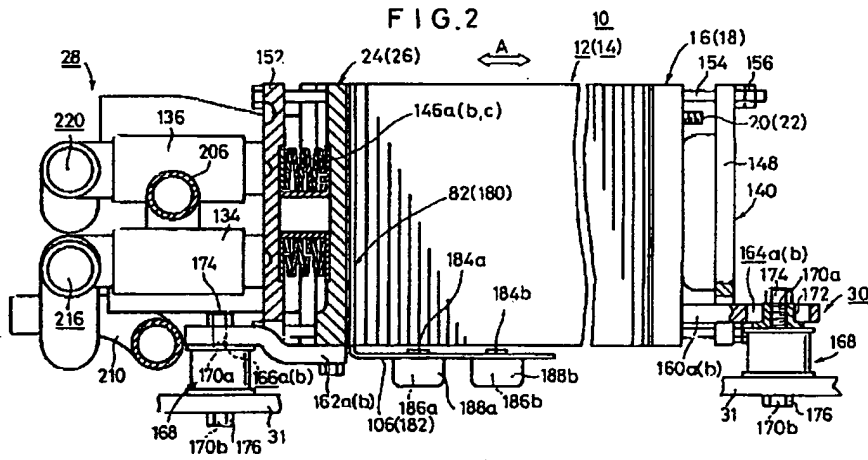
10…燃料電池システム
12、14、240、260、300、320、340…燃料電池スタック
16、18、24、26、302…エンドプレート
20、22…電力取り出し端子 28…配管機構
30…取り付け機構 32…単位燃料電池セル
34、36…セパレータ 38…電解質膜
40…カソード側電極 42…アノード側電極
56a、66a、100a、120a…酸化剤ガス入口
56b、66b、100b、120b…酸化剤ガス出口
58a、68a、102a、122a…燃料ガス入口
58b、68b、102b、122b…燃料ガス出口
60a～60d、70a～70d、104a～104d…冷却媒体入口
60e～60h、70e～70h、104e～104h…冷却媒体出口
62、65…酸化剤ガス流路溝 72、73…燃料ガス流路溝
74a～74d…冷却媒体流路 80…端子板
82、180…導電プレート 106、182…接続板部
124a～124h…冷却媒体流路溝
134…供給管路 136…排出管路
140、262…締め付け機構 142…液体チャンバ
145、266…加圧手段
146a～146c、268a～268f…皿ばね
148、308、322、342…バックアッププレート
154、270…タイロッド 160a、160b…ブラケット部
162a、162b…マウントブラケット
168…ゴムマウント 186a、186b…撚り線
188a、188b…ゴムカバー
264a～264f、304a～304f…ワッシャブ

レート

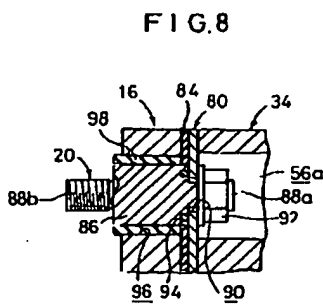
【図1】



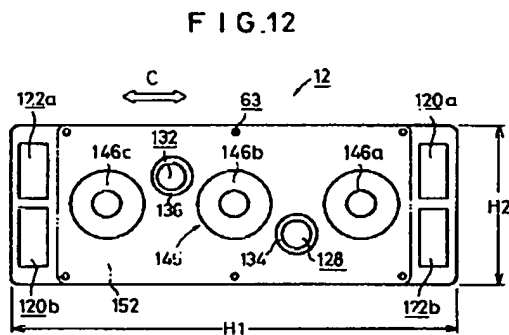
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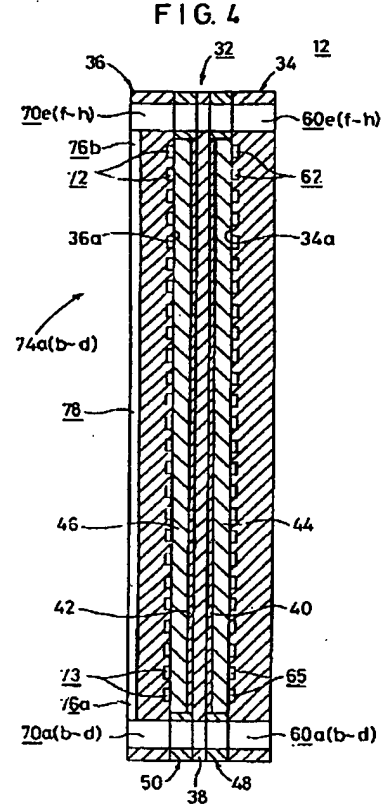
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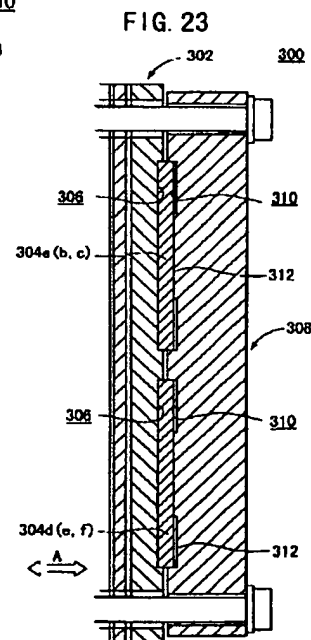
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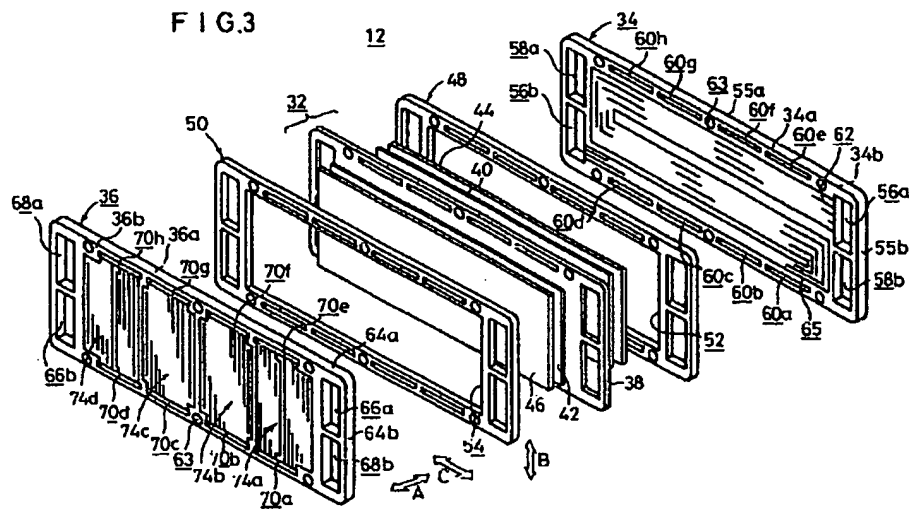
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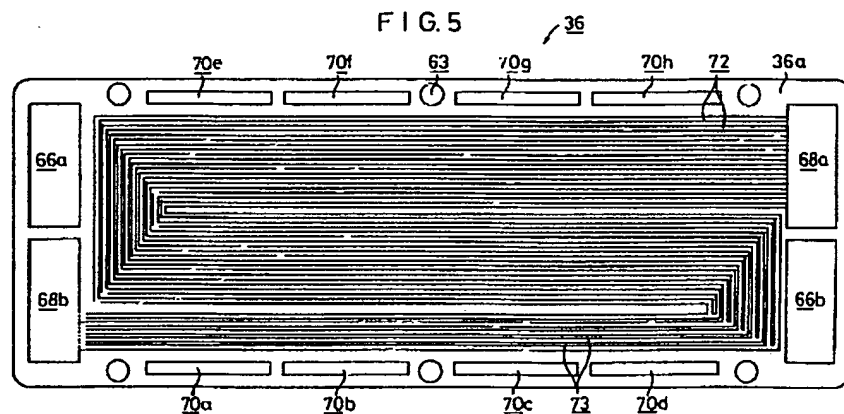
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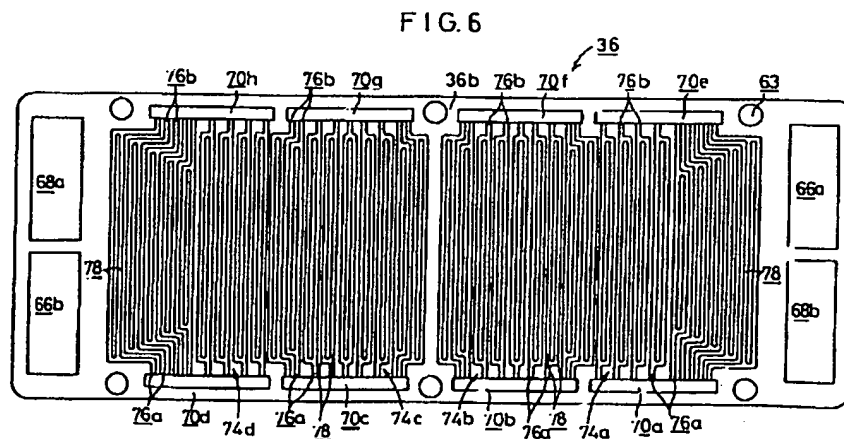
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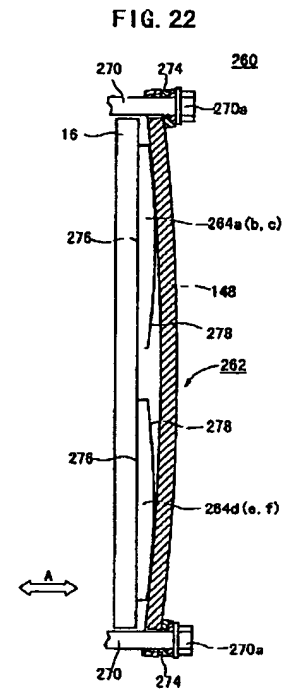
【図5】



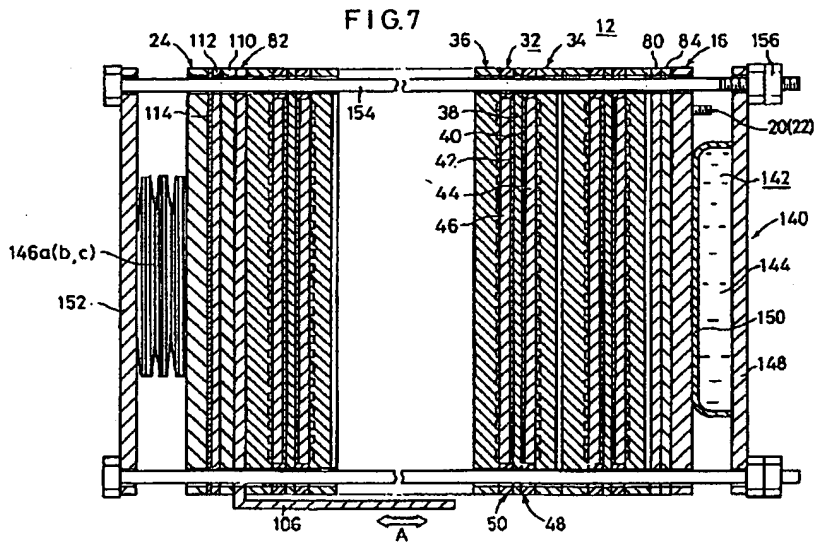
【図6】



【図22】

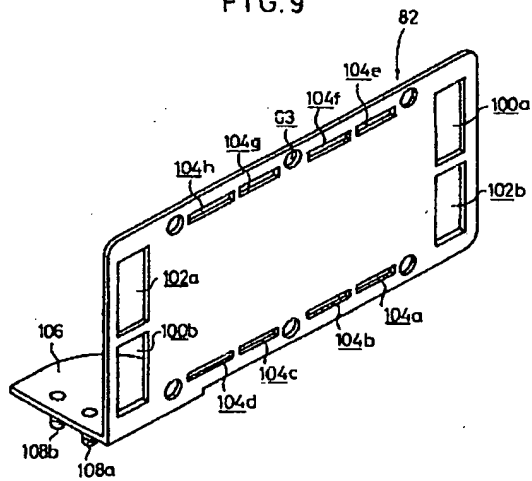


【図7】



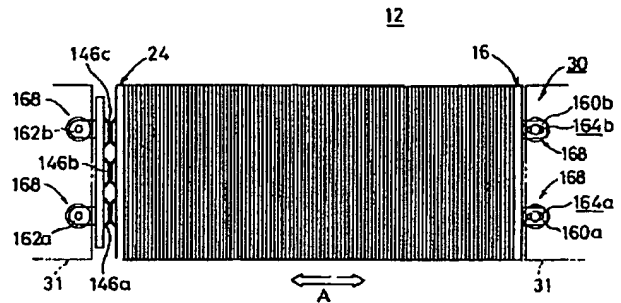
【図9】

FIG.9



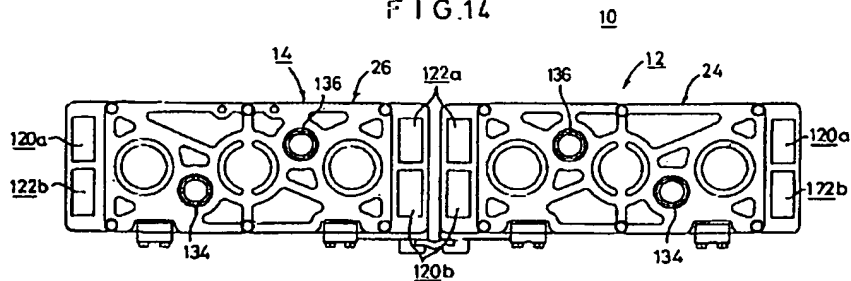
【図13】

FIG.13

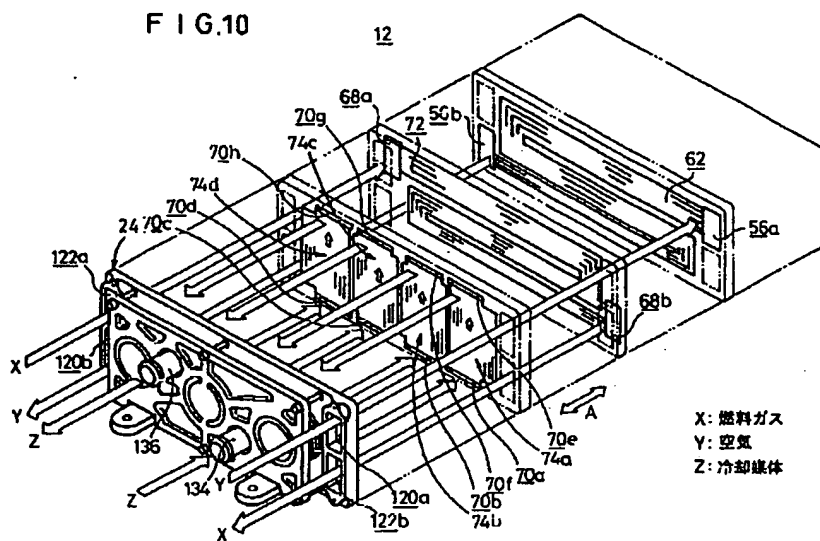


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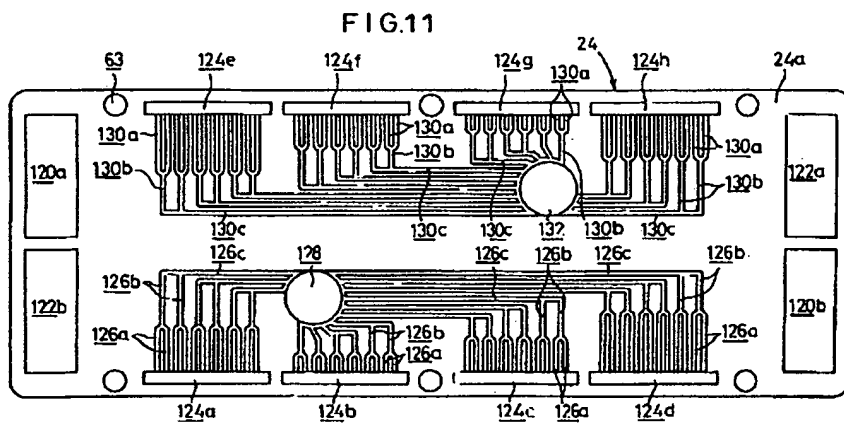
FIG.14



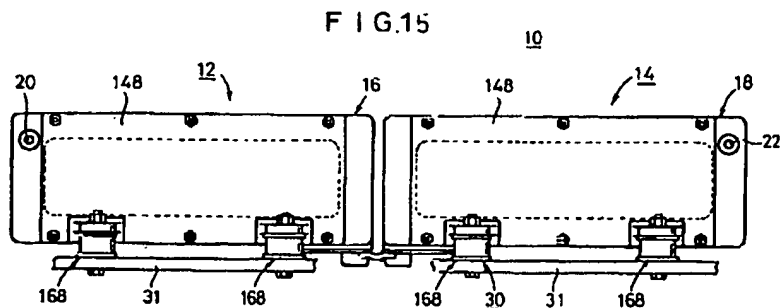
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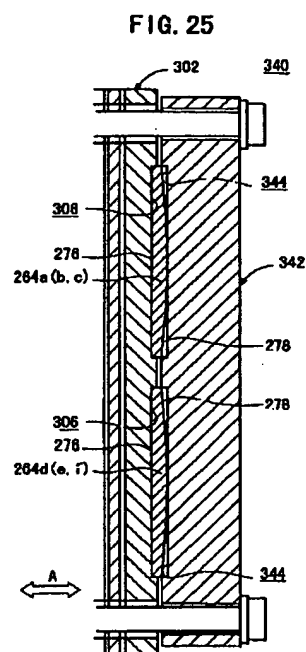
【図 1 1】



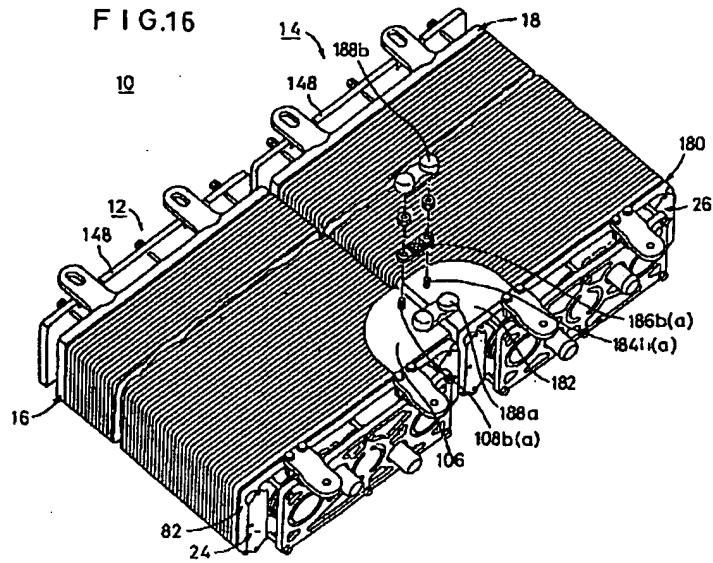
【图 15】



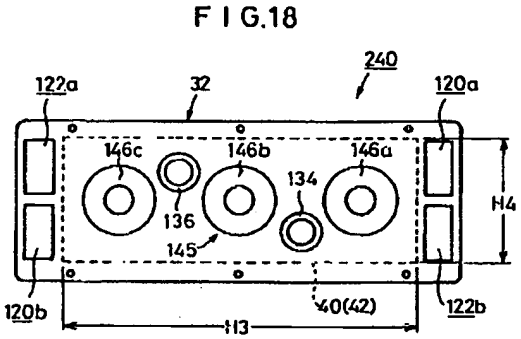
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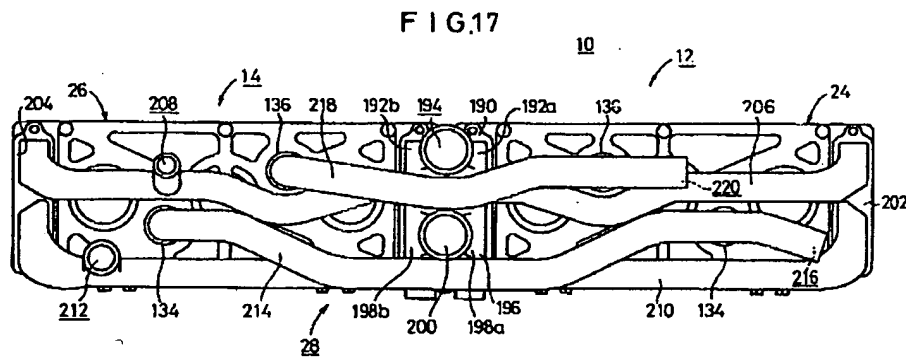
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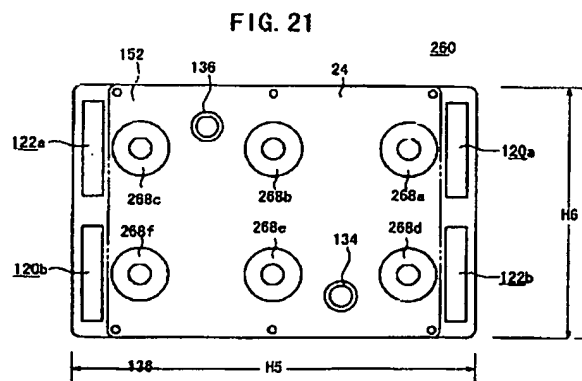
【図18】



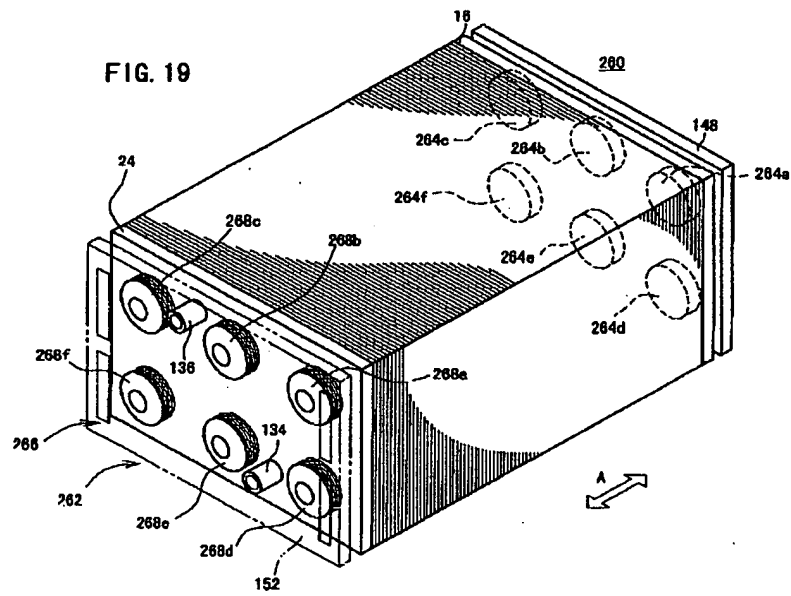
【図17】



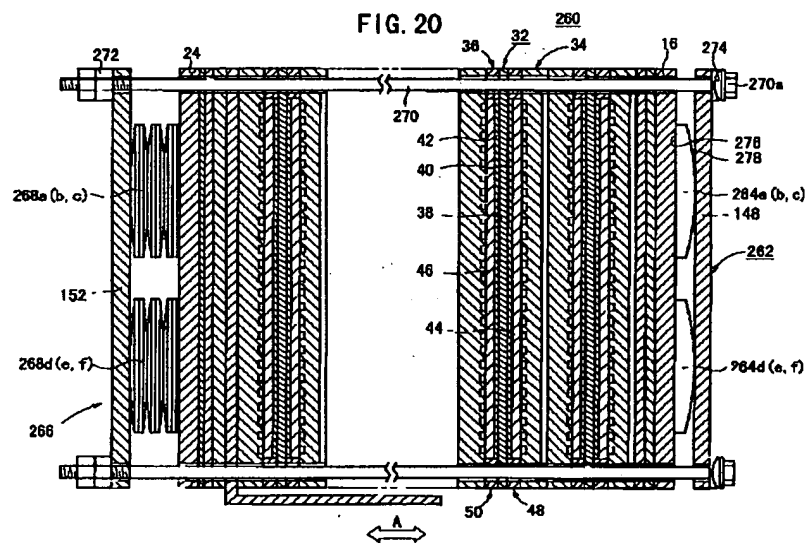
【図21】



【図19】



【図20】



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3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] While being horizontally laminated via a separator, two or more unit fuel cell cells characterized by comprising the following which comprise an anode lateral electrode and a cathode lateral electrode on both sides of solid polyelectrolyte membrane, A fuel cell stack by which an end plate is allocated in laminating direction both ends of said unit fuel cell cell.

A fluid enclosure member for planar pressure grant provided in one end-plate side.

A force means which is provided in the end-plate side of another side, and presses said unit fuel cell cell laminated to said one end-plate side.

A belleville spring of n (n is two or more integers) individual by which form width is set up more than the twice of a vertical size, and said force means is arranged in a transverse direction at one row while a preparation and said unit fuel cell cell are constituted by oblong rectangular form.

[Claim 2] A fuel cell stack, wherein a ratio of form width of said unit fuel cell cell to a vertical size is set as abbreviated n:1 in the fuel cell stack according to claim 1.

[Claim 3] While being horizontally laminated via a separator, two or more unit fuel cell cells characterized by comprising the following which comprise an anode lateral electrode and a cathode lateral electrode on both sides of solid polyelectrolyte membrane, A fuel cell stack by which an end plate is allocated in laminating direction both ends of said unit fuel cell cell.

A fluid enclosure member for planar pressure grant provided in one end-plate side.

A force means which is provided in the end-plate side of another side, and presses said unit fuel cell cell laminated to said one end-plate side.

A belleville spring of n (n is two or more integers) individual by which form width is set up more than the twice of a vertical size, and said force means is arranged in a transverse direction at one row while a power generation surface of a preparation and said unit fuel cell cell is constituted by oblong rectangular form.

[Claim 4] A fuel cell stack, wherein a ratio of form width of said power generation surface to a vertical size is set as abbreviated n:1 in the fuel cell stack according to claim 3.

[Claim 5] While being horizontally laminated via a separator, two or more unit fuel cell cells characterized by comprising the following which comprise an anode lateral electrode and a cathode lateral electrode on both sides of solid polyelectrolyte membrane, A fuel cell stack by which an end plate is allocated in laminating direction both ends of said unit fuel cell cell.

A planar pressure grant member provided in one end-plate side.

A force means which is provided in the end-plate side of another side, and presses said unit fuel cell cell laminated to said one end-plate side.

Six or more belleville springs by which said force means is arranged in a transverse direction at two rows while a preparation and said unit fuel cell cell are formed in oblong rectangular form.

[Claim 6] A fuel cell stack, wherein said planar pressure grant member is provided with six or more washer plates arranged in a transverse direction at two rows corresponding to said belleville spring in the fuel cell stack according to claim 5.

[Claim 7] A fuel cell stack, wherein a ratio of form width of said unit fuel cell cell to a vertical size is set as the abbreviation 3:2 in the fuel cell stack according to claim 5 or 6.

[Claim 8] A fuel cell stack given in any 1 paragraph of claims 5 thru/or 7 characterized by comprising the following.

A clamping bolt which penetrates said end plate, is arranged and holds said two or more unit fuel cell cells in one to a laminating direction.

A spherical washer which engages with a head of said clamping bolt.

[Translation done.]

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3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Field of the Invention] This invention relates to the fuel cell stack by which the end plate was allocated in the laminating direction both ends of said unit fuel cell cell while two or more unit fuel cell cells which comprise an anode lateral electrode and a cathode lateral electrode on both sides of solid polyelectrolyte membrane are horizontally laminated via a separator.

[0002]

[Description of the Prior Art] For example, the polymer electrolyte fuel cell is constituted by pinching with a separator the unit fuel cell cell constituted by the both sides of the electrolyte membrane which consists of a polymers ion-exchange membrane (cation exchange membrane) by an opposite *(ing) an anode lateral electrode and a cathode lateral electrode, respectively. This polymer electrolyte fuel cell is usually used as a fuel cell stack, when only a predetermined number laminates a unit fuel cell cell and a separator.

[0003] In this kind of fuel cell stack, on a catalyzer electrode, the fuel gas supplied to the anode lateral electrode, for example, hydrogen containing gas, is hydrogen-ion-ized, and it moves to the cathode lateral electrode side via the electrolyte membrane humidified moderately. The electron produced in the meantime is taken out by the external circuit, and is used as electrical energy of a direct current. Since oxidant gas, for example, oxygen containing gas, or air is supplied, in this cathode lateral electrode, said hydrogen ion, said electron, and oxygen gas react to a cathode lateral electrode, and water is generated.

[0004] By the way, if the contact resistance in a fuel cell stack increases, an internal resistance loss will increase and terminal voltage will fall. For this reason, it is necessary to give desired clamping force to each unit fuel cell cell laminated so that the planar pressure given to an electrode surface (power generation surface) may become uniform, in order to reduce contact resistance.

[0005] Then, for example, as indicated by the U.S. Pat. No. 5,484,666 gazette, While forming every two-piece a total of four crevices in a sliding direction and a horizontal direction and arranging a belleville spring to this crevice at one side of the end plate arranged to the both ends of the fuel cell stack, The fuel cell stack constituted so that said whole fuel cell stack might be bound tight and it might fix is known by inserting in a tie rod over both end plates in said belleville spring, and screwing a nut in the end of said tie rod.

[0006]

[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional technology, since it formed two crevices in the end plate at a time at the upper and lower sides and right and left, respectively and the belleville spring is arranged, as the whole fuel cell stack, the size of the height direction is equivalent to a lateral size, or serves as a size beyond it. For this reason, when it is going to carry a fuel cell stack in vehicles etc. especially, the place in which this fuel cell stack can be accommodated will be limited fairly.

[0007] And in the above-mentioned conventional technology, four belleville springs are only arranged to an end plate. Thereby, there is a possibility that uniform planar pressure cannot be given all over the

power generation surface of a unit fuel cell cell via a belleville spring.

[0008]This invention solves this kind of problem.

The purpose is providing the fuel cell stack which can give uniform clamping force to the whole unit fuel cell cell laminated while short-length-izing effectively the size of the height direction of the whole fuel cell stack.

[0009]

[Means for Solving the Problem]In a fuel cell stack concerning claim 1 of this invention, while two or more unit fuel cell cells are laminated horizontally, this unit fuel cell cell is constituted by oblong rectangular form, and that form width is set up more than the twice of that vertical size. For this reason, when a size of a height direction of the whole fuel cell stack is short-length-ized effectively, for example, being carried in vehicles etc., while being able to utilize effectively a space by the side of the upper part of said fuel cell stack, it becomes possible to accommodate this fuel cell stack in an under floor of a car body, etc. easily.

[0010]While a fluid enclosure member for planar pressure grant is provided in one end-plate side of a fuel cell stack, a force means which equipped a transverse direction with two or more belleville springs arranged at one row is arranged at the end-plate side of another side. Thereby, uniform planar pressure is certainly given to the whole unit fuel cell cell laminated under a pressing action of a force means. And two or more belleville springs are arranged at one row, a belleville spring can be uniformly arranged along with shape of a unit fuel cell cell, and it becomes possible to give clamping force suitably and firmly to said unit fuel cell cell.

[0011]In a fuel cell stack concerning claim 2, a ratio of form width of a unit fuel cell cell to a vertical size is set as an integer ratio of abbreviated $n:1$. For this reason, while making height of the whole fuel cell stack still lower, two or more belleville springs can be uniformly arranged to the whole unit fuel cell cell surface, and it becomes possible to equalize said planar pressure given all over a unit fuel cell cell much more with high precision.

[0012]In a fuel cell stack concerning claim 3, while two or more unit fuel cell cells are laminated horizontally, a power generation surface of this unit fuel cell cell is constituted by oblong rectangular form, and that form width is set up more than the twice of that vertical size. Therefore, uniform planar pressure can be certainly given to each whole power generation surface of a unit fuel cell cell laminated.

[0013]By a fuel cell stack concerning claim 4, a ratio of form width of a power generation surface of a unit fuel cell cell to a vertical size is set as an integer ratio of abbreviated $n:1$ further again. Thereby, two or more belleville springs can be uniformly arranged to the whole power generation surface surface, and it becomes possible to equalize said planar pressure given all over a power generation surface much more with high precision.

[0014]In a fuel cell stack concerning claim 5, while a unit fuel cell cell is formed in oblong rectangular form, a planar pressure grant member is provided in one end-plate side, and a force means which equips the end-plate side of another side with six or more belleville springs arranged in a transverse direction at two rows is arranged. for this reason -- falling at the time of an assembly, while giving uniform planar pressure to the whole unit fuel cell cell -- etc. -- it does not cause and assembling work of a fuel cell stack is carried out with high precision and efficiently.

[0015]A planar pressure grant member is provided with six or more washer plates arranged in a transverse direction at two rows corresponding to a belleville spring in a fuel cell stack concerning claim 6. Therefore, composition simplifies and it will become economical, and since each belleville spring and each washer plate counter mutually and are moreover arranged, it becomes possible to prevent moment load from giving certainly and to bind the whole fuel cell stack tight firmly and certainly. By moreover using a washer plate, the thinning of the size of a laminating direction of a unit fuel cell cell which is a thickness direction is carried out, and a laminating direction of the whole fuel cell stack can be short-length-ized effectively.

[0016]By a fuel cell stack concerning claim 7, a ratio of form width of a unit fuel cell cell to a vertical

size is set as the abbreviation 3:2 further again. For this reason, especially, two rows of a total of six or more belleville springs can be uniformly arranged to the whole unit fuel cell surface in each transverse direction, and said thing [giving planar pressure with high precision and uniformly all over a unit fuel cell] becomes possible.

[0017]In a fuel cell stack concerning claim 8, it has a clamping bolt which holds a unit fuel cell in one to a laminating direction, and a spherical washer which engages with a head of said clamping bolt. When carrying out application-of-pressure maintenance of the whole fuel cell stack by this in a laminating direction, even if an end plate and the back up plate which support a clamping bolt change, clamping force of a laminating direction can be certainly given to a fuel cell stack under an operation of a spherical washer.

[0018]

[Embodiment of the Invention]Drawing 1 is an outline strabism explanatory view of the fuel cell system 10 incorporating the fuel cell stack concerning a 1st embodiment of this invention, and drawing 2 is a side explanatory view of said fuel cell system 10.

[0019]The fuel cell system 10 is provided with the 1st fuel cell stack 12 and the 2nd fuel cell stack 14 which are mutually arranged in parallel along a horizontal direction (the direction of arrow A). The 2nd electric power extraction terminal 22 which is the 1st electric power extraction terminal 20 and negative electrode which are anodes is formed in the 1st end plate 16 and 18 that constitutes the end part vertical plane by the side of the same of the 1st and 2nd fuel cell stacks 12 and 14.

[0020]The piping mechanism 28 for performing supply and discharge of fuel gas, oxidant gas, and a cooling medium to said 1st and 2nd fuel cell stacks 12 and 14 is included in the 2nd end-plate 24 and 26 side which is an other end vertical plane by the side of the same of the 1st and 2nd fuel cell stacks 12 and 14. The 1st and 2nd fuel cell stacks 12 and 14 are fixed to the attaching plate 31 which constitutes vehicles via the mounting mechanism 30.

[0021]The 1st fuel cell stack 12 is provided with the 1st and 2nd separators 34 and 36 that pinch the unit fuel cell 32 and this unit fuel cell 32 as shown in drawing 3 and drawing 4, and two or more sets of these are laminated horizontally (the direction of arrow A). A long side direction (the direction of arrow C) directs horizontally, and the 1st fuel cell stack 12 is arranged while it has rectangular parallelepiped shape as a whole and a short side direction (the direction of arrow B) directs in a gravity direction.

[0022]While the unit fuel cell 32 has the solid polyelectrolyte membrane 38, and the cathode lateral electrode 40 and the anode lateral electrode 42 which are allocated on both sides of this electrolyte membrane 38, The 1st and 2nd gas diffusion layers 44 and 46 that consist of porosity carbon paper etc. which are porous layers, for example are allocated by said cathode lateral electrode 40 and said anode lateral electrode 42.

[0023]They are formed in the both sides of the unit fuel cell 32 by the 1st and 2nd gaskets 48 and 50, and said 1st gasket 48, While it has the big opening 52 for storing the cathode lateral electrode 40 and the 1st gas diffusion layer 44, said 2nd gasket 50 has the big opening 54 for storing the anode lateral electrode 42 and the 2nd gas diffusion layer 46. The unit fuel cell 32 and the 1st and 2nd gaskets 48 and 50 are pinched with the 1st and 2nd separators 34 and 36.

[0024]The shorter side 55b directs in a gravity direction, and the 1st separator 34 is arranged while the field 34a which counters the cathode lateral electrode 40, and the field 34b of the opposite hand are set as rectangular form, for example, the long side 55a directs horizontally.

[0025]The oxidizing agent gas inlet 56a for passing the oxidant gas which is oxygen gas or air, and the fuel gas inlet 58a for passing fuel gas, such as hydrogen gas, have long picture rectangular form, and are established in a sliding direction at the both-ends edge upper part side by the side of the shorter side 55b of the 1st separator 34. It has long picture rectangular form in a sliding direction, and the oxidant gas exit 56b and the fuel gas outlet 58b are established in it at the both-ends edge lower part side by the side of the shorter side 55b of the 1st separator 34 so that it may become the oxidizing agent gas inlet 56a and the fuel gas inlet 58a, and a diagonal position.

[0026]While the four cooling-medium entrances [long picture / the direction of arrow C] 60a-60d are

established in the lower end part of the long side 55a of the 1st separator 34, the four cooling-medium exits [long picture / the direction of arrow C] 60e-60h are similarly established in the upper part by the side of the long side 55a of this 1st separator 34. Cooling media, such as pure water, ethylene glycol, and oil, are supplied to the cooling-medium entrances 60a-60d.

[0027]The ten 1st oxidant gas passage grooves 62 it is open for free passage to the oxidizing agent gas inlet 56a and which became independent, respectively are established in the field 34a of the 1st separator 34 toward a gravity direction, moving in a zigzag direction horizontally. The 1st oxidant gas passage groove 62 joins the five 2nd oxidant gas passage grooves 65, and said 2nd oxidant gas passage groove 65 opens it for free passage to the oxidant gas exit 56b. The pore 63 for tie rod insertion is formed in six places at the 1st separator 34.

[0028]The 2nd separator 36 is formed in rectangular form, and to the both-ends edge upper part side by the side of the shorter side 64b of this 2nd separator 36. While penetration formation of the oxidizing agent gas inlet 66a and the fuel gas inlet 68a is carried out, penetration formation of the oxidant gas exit 66b and the fuel gas outlet 68b is carried out at the both-ends edge lower part side so that it may become said oxidizing agent gas inlet 66a and said fuel gas inlet 68a, and a diagonal position.

[0029]Penetration formation of the four cooling-medium entrances [long picture / the direction of arrow C] 70a-70d is carried out at the lower part by the side of the long side 64a of the 2nd separator 36, and penetration formation of the cooling-medium exits 70e-70h is similarly carried out in the direction of arrow C in the upper part by the side of this long side 64a at a long picture.

[0030]As shown in drawing 5, it is open for free passage to the fuel gas inlet 68a, and the ten 1st fuel gas flow route slots 72 are formed in the field 36a of the 2nd separator 36. This 1st fuel gas flow route slot 72 is formed toward a gravity direction, moving in a zigzag direction horizontally, the five 2nd fuel gas flow route slots 73 are joined, and said 2nd fuel gas flow route slot 73 is open for free passage to the fuel gas outlet 68b.

[0031]As shown in drawing 6, the cooling-medium channels 74a-74d which are individually open for free passage, respectively are established in the field 36b of an opposite hand toward a gravity direction at the cooling-medium entrances 70a-70d and the cooling-medium exits 70e-70h in the field 36a of the 2nd separator 36. While the cooling-medium channels 74a-74d are provided with the 1st passage groove 76a and 76b of nine each which is open for free passage to the cooling-medium entrances 70a-70d and the cooling-medium exits 70e-70h, Between said 1st passage groove 76a and 76b, mutually, in parallel with a gravity direction, the 2nd two passage grooves 78 estrange a prescribed interval every, and are provided, respectively. The pore 63 for tie rod insertion is formed in six places like [the 2nd separator 36] the 1st separator 34.

[0032]As shown in drawing 7, the tag block 80 and the 1st electric conduction plate 82 which are terminal plates are allocated in the laminating direction both ends of the unit fuel cell cell 32 to which only the predetermined number was laminated. While the 1st end plate 16 is laminated via the electric insulating plate 84 by the tag block 80, this tag block 80 is equipped with the 1st electric power extraction terminal 20.

[0033]As shown in drawing 8, the 1st electric power extraction terminal 20 provides the byway thread parts 88a and 88b in the both ends of the cylindrical major diameter 86. This thread part 88a is projected in the oxidizing agent gas inlet 56a of the 1st separator 34 through the pore 90 formed in the tag block 80, and the nut member 92 is screwed on said thread part 88a. In order to raise the sealing nature between the tag blocks 80 in the shoulder of the major diameter 86, while the sealing member 94 is infixed in it, the insulating ring 98 is infixed between the periphery of said major diameter 86, and the pore 96 formed in the 1st end plate 16.

[0034]As shown in drawing 9, the 1st electric conduction plate 82, It is mostly set to the 2nd separator 36 at identical shape, i.e., rectangular form, and the oxidizing agent gas inlet 100a, the fuel gas inlet 102a and the oxidant gas exit 100b, and the fuel gas outlet 102b are mutually established in the both-ends edge by the side of a shorter side in the diagonal position. While the four cooling-medium entrances 104a-104d and cooling-medium exits 104e-104h are established in the long side back lower part and the upper part of the 1st electric conduction plate 82, respectively, the pore 63 for tie rod

insertion is formed in six places.

[0035]the 1st electric conduction plate 82 -- the 1st fuel cell stack 12 bottom -- and the 1st connection plate part 106 which approaches the 2nd fuel cell stack 14 and extends is formed. It projects in the 1st connection plate part 106 caudad, the two bolt parts 108a and 108b are formed in it, and these bolt parts 108a and 108b and the 1st electric conduction plate 82 comprise material which has conductivity, for example, SUS, copper, etc. As shown in drawing 7, the 2nd end plate 24 is laminated by the 1st electric conduction plate 82 via the electric insulating plate 110, the cover plate 112, and the sealing member 114.

[0036]As shown in drawing 10 and drawing 11, the 2nd end plate 24 is constituted by rectangular form, and to the both-ends edge upper part side by the side of the shorter side. While penetration formation of the oxidizing agent gas inlet 120a and the fuel gas inlet 122a is carried out, it is provided in the both-ends edge lower part side by the side of the shorter side so that the oxidant gas exit 120b and the fuel gas outlet 122b may become said oxidizing agent gas inlet 120a and said fuel gas inlet 122a, and a diagonal position.

[0037]In the field 24a inside the 2nd end plate 24. It is a long picture horizontally, and the 1st cooling-medium passage grooves 124a-124d which are open for free passage at the cooling-medium entrances 70a-70d of the 2nd separator 36, and the 2nd cooling-medium passage grooves 124e-124h which are open for free passage to the cooling-medium exits 70e-70h of said 2nd separator 36 have the predetermined depth, and are formed. The 1st cooling-medium passage grooves 124a-124d are open for free passage at the end of the 1st 12 slots 126a, respectively. Two join at a time, respectively, the 2nd slot 126b is formed, every two of said 2nd slot 126b join the 3rd slot 126c, respectively, and the 1st slot 126a is open for free passage to the single cooling-medium feed hopper 128, after extending up in parallel mutually.

[0038]Similarly, it is open for free passage to the 1st 12 slots 130a, respectively, said 1st slot 130a extends in perpendicular down, and the 2nd cooling-medium passage grooves 124e-124h join the 2nd slot 130b two [at a time]. The 2nd slot 130b joins the 3rd slot 130c two [at a time], and is open for free passage to the single cooling-medium outlet 132. As shown in drawing 10, the supply line 134 and the exhaust pipe way 136 are connected with the cooling-medium feed hopper 128 and the cooling-medium outlet 132, and this supply line 134 and this exhaust pipe way 136 have projected only predetermined length outside the 1st fuel cell stack 12 to them at the way. The pore 63 for tie rod insertion is formed in six places at the 2nd end plate 24 (refer to drawing 11).

[0039]As shown in drawing 7, via the clamping mechanism 140, the 1st fuel cell stack 12 is bound tight to a laminating direction (the direction of arrow A) in one, and is fixed to it. The clamping mechanism 140 is provided with the following.

The fluid chamber 142 provided in the outside surface side of the 1st end plate 16.

The incompressible fluid 144 for planar pressure grant enclosed in this fluid chamber 142, for example, a silicone oil

Force means 145.

This force means 145 is formed in the outside surface side of the 2nd end plate 24, and in order to press said 2nd end plate 24 to the 1st end-plate 16 side, it is provided with two or more and the three belleville springs 146a-146c which estrange a prescribed interval every horizontally and are arranged at one row.

[0040]The 1st end plate 16 is countered on both sides of the fluid chamber 142, the back up plate 148 is allocated, and the fluid enclosure member for planar pressure grant which formed the fluid chamber 142 with the sheet metal 150 of this back up plate 148, aluminum, or a stainless steel is constituted. The belleville springs 146a-146c are supported by the adapter plate 152 while estranging them abbreviation regular intervals every and arranging them in the field of the 2nd end plate 24. The 1st fuel cell stack 12 is penetrated from the adapter plate 152, and the six tie rods 154 are inserted in the back up plate 148. By thrusting the nut 156 into the end of the tie rod 154, the 1st fuel cell stack 12 is held in one.

[0041]As shown in drawing 12, while the 1st fuel cell stack 12 (namely, unit fuel cell cell 32) is constituted by oblong rectangular form, the form width H1 is set up more than the twice of the vertical size H2.

[0042]a 1st embodiment -- the ratio of the form width H1 to the vertical size H2 -- abbreviated $n(n$ is two or more integers):1 -- for example, -- abbreviated -- it is set as the integer ratio of 3:1. In order to give uniform planar pressure all over each unit fuel cell cell 32, to the 1st fuel cell stack 12, the three belleville springs 146a-146c estrange regular intervals every corresponding to the ratio of the form width H1 to the vertical size H2, and it is arranged horizontally (the direction of arrow C). If it puts in another way, the belleville springs 164a-164c of the number corresponding to the ratio can be uniformly arranged to the whole surface of the unit fuel cell cell 32 by setting the ratio of the form width H1 of the unit fuel cell cell 32 to the vertical size H2 as an integer ratio.

[0043]As shown in drawing 2 and drawing 13, the mounting mechanism 30 is provided with the following.

The bracket parts 160a and 160b provided in the lower part side of the 1st end plate 16 in one.

The mount brackets 162a and 162b screwed to the lower part side of the 2nd end plate 24.

While the long picture long holes 164a and 164b are formed in the laminating direction (the direction of arrow A) of the 1st fuel cell stack 12 at the bracket parts 160a and 160b, the pores 166a and 166b are formed in the mount brackets 162a and 162b.

[0044]The rubber mount 168 is arranged at the long holes 164a and 164b and the pores 166a and 166b, respectively. The nut 174 is screwed in this thread part 170a, while the color 172 is arranged at said thread part 170a to which the thread parts 170a and 170b are formed up and down, and the rubber mount 168 projects in the upper part and this color 172 is inserted in the long holes 164a and 164b from here. In the mount bracket 162a and b [162] side, the thread part 170a of the rubber mount 168 is inserted in the pores 166a and 166b, and the nut 174 is screwed in the tip part. The thread part 170b which projects in the lower part side of the rubber mount 168 fixes the 1st fuel cell stack 12 to vehicles etc. by being inserted in the attaching plate 31 and screwing the nut 176.

[0045]As shown in drawing 14, the 2nd fuel cell stack 14, While being constituted symmetrically [the 1st fuel cell stack 12 mentioned above], the cathode lateral electrode 40 and the anode lateral electrode 42 are arranged to the electrolyte membrane 38 at the reverse side, and the 2nd electric power extraction terminal 22 which is a negative electrode is formed in the 1st end-plate 18 side (refer to drawing 15). The 2nd fuel cell stack 14 is fundamentally constituted like the 1st fuel cell stack 12, gives the same reference mark to the same component, and omits the detailed explanation.

[0046]As shown in drawing 16, the 2nd fuel cell stack 14, The 2nd connection plate part 182 close to the 1st connection plate part 106 of the 1st electric conduction plate 82 which is provided with the 2nd electric conduction plate 180, and extends on this 2nd electric conduction plate 180 at said 2nd fuel cell stack 14 bottom, and is provided in the 1st fuel cell stack 12 is formed. The bolt parts 108a and 108b of a couple, and 184a and 184b are provided in the 1st and 2nd connection plate parts 106 and 182, respectively.

[0047]The flexible connection body 186a and 186b, for example, stranded wires, is connected to the bolt parts 108a and 184a and the bolt parts 108b and 184b, respectively. The stranded wires 186a and 186b are constituted by twisting the lead of much thin line state to mesh texture, and are covered with the rubber covers 188a and 188b, respectively.

[0048]As shown in drawing 14, to the 2nd end plate 24 and 26 that constitutes the 1st and 2nd fuel cell stacks 12 and 14. The fuel gas inlet 122a and the oxidant gas exit 120b are arranged at the position which approaches mutually, respectively, and the piping mechanism 28 is included in this 2nd end plate 24 and 26.

[0049]As shown in drawing 1 and drawing 17, the piping mechanism 28, It has the 1st bracket 190 that covers each fuel gas inlet 122a of the 2nd end plate 24 and 26 that constitutes the 1st and 2nd fuel cell stacks 12 and 14 installed side by side mutually, and is fixed to said 2nd end plate 24 and 26 in one. The fuel gas supply pipes 192a and 192b which are open for free passage, respectively are formed in each fuel gas inlet 122a, said fuel gas supply pipes 192a and 192b join this 1st bracket 190, and it is open for free passage to the fuel gas feed hopper 194.

[0050]Each oxidant gas exit 120b is covered to the 2nd end plate 24 and 26, and the 2nd bracket 196 is fixed to it. The tip part of the oxidant gas exhaust pipes 198a and 198b which are formed in this 2nd

bracket 196 and are open for free passage to the oxidant gas exit 120b, respectively is open for free passage in one to the oxidant gas outlet 200.

[0051] Each oxidizing agent gas inlet 120a and fuel gas outlet 122b are covered to the 2nd end plate 24 and 26, and the 3rd and 4th brackets 202 and 204 are fixed to it. While the both ends of the oxidant gas feed pipe 206 which is open for free passage to the oxidizing agent gas inlet 120a are open for free passage to the 3rd and 4th brackets 202 and 204, the oxidant gas feed hopper 208 is established in the way of this oxidant gas feed pipe 206. To the 3rd and 4th brackets 202 and 204, the both ends of the fuel gas exhaust pipe 210 which is open for free passage to the fuel gas outlet 122b are open for free passage, and the fuel gas outlet 212 is formed in the way of this fuel gas exhaust pipe 210.

[0052] The both ends of the cooling medium supplying pipe 214 are connected with each supply line 134 established in the 2nd end plate 24 and 26, and the cooling-medium feed hopper 216 is established in this cooling medium supplying pipe 214. While the cooling medium discharge pipe 218 is connected with each exhaust pipe way 136 established in the 2nd end plate 24 and 26, the cooling-medium outlet 220 is formed in this cooling medium discharge pipe 218.

[0053] Operation of the fuel cell system 10 constituted in this way is explained below.

[0054] As shown in drawing 1, while fuel gas (for example, gas containing the hydrogen which reformed hydrocarbon) is supplied to the fuel cell system 10 from the fuel gas feed hopper 194, air or oxygen gas (only henceforth air) is supplied to the oxidant gas feed hopper 208 as oxidant gas. A cooling medium is supplied to the cooling-medium feed hopper 216.

[0055] The fuel gas supplied to the fuel gas feed hopper 194, It is sent to each fuel gas inlet 122a of the 2nd end plate 24 and 26 that constitutes the 1st and 2nd fuel cell stacks 12 and 14 through the fuel gas supply pipes 192a and 192b, and is further introduced into the 1st fuel gas flow route slot 72 from each fuel gas inlet 68a of the 2nd separator 36. As shown in drawing 5, the fuel gas supplied to the 1st fuel gas flow route slot 72 moves to a gravity direction, moving in a zigzag direction horizontally along the field 36a of the 2nd separator 36.

[0056] In that case, hydrogen gas in fuel gas is supplied to the anode lateral electrode 42 of the unit fuel cell cell 32 through the 2nd gas diffusion layer 46. And while intact fuel gas moves along the 1st fuel gas flow route slot 72 and the anode lateral electrode 42 is supplied, intact fuel gas is discharged from the fuel gas outlet 68b via the 2nd fuel gas flow route slot 73. This intact fuel gas is introduced into the fuel gas exhaust pipe 210 through each fuel gas outlet 122b of the 2nd end plate 24 and 26, and is discharged from the fuel cell system 10 via the fuel gas outlet 212.

[0057] On the other hand, the air supplied to the oxidant gas feed hopper 208, It is sent to each oxidizing agent gas inlet 120a established in the 2nd end plate 24 and 26 via the oxidant gas feed pipe 206, and the oxidizing agent gas inlet 56a of the 1st separator 34 further incorporated in the 1st and 2nd fuel cell stacks 12 and 14 is supplied (refer to drawing 3). In the 1st separator 34, the air supplied to the oxidizing agent gas inlet 56a is introduced into the 1st oxidant gas passage groove 62 within the field 34a, and it moves to a gravity direction, moving in a zigzag direction horizontally along this 1st oxidant gas passage groove 62.

[0058] While the oxygen gas in the air is supplied to the cathode lateral electrode 40 from the 1st gas diffusion layer 44 in that case, intact air is discharged from the oxidant gas exit 56b via the 2nd oxidant gas passage groove 65. The air discharged by this oxidant gas exit 56b is discharged from the oxidant gas outlet 200 via the oxidant gas exhaust pipes 198a and 198b from the oxidant gas exit 120b established in the 2nd end plate 24 and 26 (refer to drawing 1).

[0059] By this, power generation will be performed by the 1st and 2nd fuel cell stacks 12 and 14, and electric power will be supplied to the load connected between the 1st and 2nd electric power extraction terminals 20 and 22 in which the characteristics differ, respectively, for example, the motor which is not illustrated.

[0060] The inside of the 1st and 2nd fuel cell stacks 12 and 14 is effectively cooled by a cooling medium. That is, the cooling medium supplied to the cooling-medium feed hopper 216 is introduced into the supply line 134 established in the 2nd end plate 24 and 26 from the cooling medium supplying pipe 214. As shown in drawing 11, this cooling medium is introduced into the cooling-medium feed

hopper 128 of the 2nd end plate 24 and 26, and is sent to the 1st cooling-medium passage grooves 124a-124d through the 1st slot 126a from two or more 2nd slots 126b.

[0061]The cooling medium introduced into the 1st cooling-medium passage grooves 124a-124d, It is introduced into the cooling-medium entrances 70a-70d formed in the lower part side of the 2nd separator 36, and as shown in drawing 6, it moves toward the upper part along the cooling-medium channels 74a-74d which are open for free passage at said cooling-medium entrances 70a-70d from a lower part. The cooling medium which cooled each unit fuel cell cell 32 through the cooling-medium channels 74a-74d is introduced into the 2nd cooling-medium passage grooves 124e-124h of the 2nd end plate 24 and 26 through the cooling-medium exits 70e-70h (refer to drawing 11).

[0062]The cooling medium introduced into these 2nd cooling-medium passage grooves 124e-124h is sent to the cooling-medium outlet 132 via the 2nd slot 130b from the 1st slot 130a, and is discharged from the cooling-medium outlet 220 through the cooling medium discharge pipe 218 from the exhaust pipe way 136.

[0063]in this case, a 1st embodiment shows to drawing 12 -- as -- the ratio of the form width H1 of the 1st fuel cell stack 12 (namely, unit fuel cell cell 32), and the vertical size H2 -- abbreviated -- it is set as 3:1. And the fluid chamber 142 by which the clamping mechanism 140 is formed in the outside surface side of the 1st end plate 16 in order to give planar pressure to a laminating direction to the 1st fuel cell stack 12, It was provided in the outside surface side of the 2nd end plate 24, and has the three belleville springs 146a-146c arranged in a transverse direction at one row corresponding to the aspect ratio of the 1st fuel cell stack 12.

[0064]Thus, in a 1st embodiment, since the belleville springs 146a-146c are set up corresponding to the aspect ratio of the unit fuel cell cell 32, the planar pressure distribution in the 1st fuel cell stack 12 becomes uniform. Thereby, while raising power generation performance effectively, the leakage of fuel gas or oxidant gas is prevented, and the effect that effective sealing nature is securable is acquired.

[0065]And the ratio of the form width H1 of the unit fuel cell cell 32 to the vertical size H2 is set to the integer ratio 3:1, for example, abbreviation. Therefore, if the belleville springs 164a-164c of the number corresponding to the integer ratio are used, said belleville springs 164a-164c can be uniformly arranged to the whole surface of the unit fuel cell cell 32. The oxidant gas communicating path which includes by this the oxidizing agent gas inlet 56a and the oxidant gas exit 56b which were especially established in the both ends of the unit fuel cell cell 32, It becomes possible to give uniform clamping force to the circumference of a fuel gas communicating path including the fuel gas inlet 68a and the fuel gas outlet 68b, and there is an advantage that the sealing nature of oxidant gas and fuel gas is maintainable with high precision.

[0066]The 1st fuel cell stack 12 can be constituted oblong, and it becomes possible to set up fairly the size of the height direction of said 1st fuel cell stack 12 low. Therefore, the fuel cell system 10 has desired electromotive force, can reduce the sizes of a height direction substantially, and has the advantage of becoming possible to use it effectively as the fuel cell system 10 for mount especially.

[0067]While the 1st and 2nd fuel gas flow route slots 72 and 73 lie in a zigzag line horizontally and being provided in one field 36a toward a gravity direction in the 2nd separator 36, The 1st passage groove 76a and 76b and the 2nd passage groove 78 which constitute the cooling-medium channels 74a-74d are established in the field 36b of said 2nd separator 36 toward the gravity direction.

[0068]Thus, in the 2nd separator 36, the 1st and 2nd fuel gas flow route slots 72 and 73 and the 1st and 2nd passage grooves 76a, 76b, and 78 are formed so that it may intersect perpendicularly mutually, and the flexural rigidity of said 2nd separator 36 very thing improves effectively. It becomes possible to carry out the thinning of the thickness of the 2nd separator 36 effectively by this, and it becomes possible to short-length-ize easily the size of the laminating direction of the 1st fuel cell stack 12 whole.

[0069]Although a 1st embodiment explained the 1st and 2nd fuel cell stacks 12 and 14 using the fuel cell system 10 which the laminating direction was made to arrange in parallel, the same effect is acquired also when using only the 1st fuel cell stack 12.

[0070]Drawing 18 is a transverse-plane explanatory view of the fuel cell stack 240 concerning a 2nd embodiment of this invention. The same reference mark is given to the same component as the 1st fuel

cell stack 12 concerning a 1st embodiment, and the detailed explanation is omitted. Also in the fuel cell stack 260 concerning a 3rd embodiment described below, it is the same.

[0071]In this fuel cell stack 240, the cathode lateral electrode 40 and the anode lateral electrode 42 which constitute the power generation surface of the unit fuel cell cell 32 have oblong rectangular form, and that form width H3 is set up more than the twice of that vertical size H4. a 2nd embodiment -- the ratio of the form width H3 to the vertical size H4 -- abbreviated n(n is two or more integers):1 -- for example, -- abbreviated -- it is set as the integer ratio of 3:1.

[0072]Corresponding to the ratio of the form width H3 of a power generation surface to the vertical size H4, in the fuel cell stack 240, the three belleville springs 146a-146c estrange regular intervals every, and are arranged horizontally (the direction of arrow C) at it. That is, the belleville springs 146a-146c of the number corresponding to the ratio can be uniformly arranged to the whole power generation surface surface by setting the ratio of the form width H3 of the power generation surface of the unit fuel cell cell 32 to the vertical size H4 as an integer ratio.

[0073]Thereby, in a 2nd embodiment, it becomes possible to give uniform clamping force all over the power generation surface in the fuel cell stack 240, and the effect that power generation performance can be raised effectively is acquired.

[0074]Drawing 19 is an outline strabism explanatory view of the fuel cell stack 260 concerning a 3rd embodiment of this invention, and drawing 20 is an outline vertical section explanatory view of said fuel cell stack 260.

[0075]Via the clamping mechanism 262, the fuel cell stack 260 is bound tight to a laminating direction in one, and is fixed to it. This clamping mechanism 262 is provided with the following.

Six or more pieces, the six washer plates 264a-264f which are the planar pressure grant members arranged between the 1st end plate 16 and the back up plate 148.

The force means 266 provided in the outside surface side of the 2nd end plate 24.

[0076]The curving surface 278 which is a surface of a sphere or a circular face is established in the side in contact with the back up plate 148, and the washer plates 264a-264f are set up in the shape of an approximate circle board as a whole, while establishing the flat face 276 in the side which touches the 1st end plate 16. The washer plates 264a-264f are horizontally estranged a prescribed interval every to the 1st end-plate 16 side, and are arranged at two rows of upper and lower sides.

[0077]The force means 266 is provided with six or more pieces and the six belleville springs 268a-268f which estrange a prescribed interval every horizontally and are arranged at two rows of upper and lower sides, in order to be provided in the outside surface side of the 2nd end plate 24 and to press this 2nd end plate 24 to the 1st end-plate 16 side. The belleville springs 268a-268c are set as the position which goes to the upper part side of the 2nd end plate 24 horizontally, and is arranged, and is abbreviated-in agreement in the washer plates 264a-264c and the direction of arrow A. the belleville springs 268d-268f -- the lower part side of the 2nd end plate 24 -- and it is arranged corresponding to the position which is abbreviated-in agreement in the washer plates 264d-264f and the direction of arrow A.

[0078]The fuel cell stack 260 is penetrated from the back up plate 148, and the six tie rods (clamping bolt) 270 are inserted in the adapter plate 152. As shown in drawing 20, while the nut 272 is thrust into the end of the tie rod 270, the spherical washer 274 is infixed between the head 270a of said tie rod 270, and the back up plate 148.

[0079]As shown in drawing 21, while the fuel cell stack 260 is formed in oblong rectangular form, the ratio of the form width H5 and the vertical size H6 is set as the abbreviation 3:2.

[0080]According to a 3rd embodiment constituted in this way, it estranges regular intervals every horizontally [are two rows of upper and lower sides, and] in the field of the 2nd end plate 24, and the six belleville springs 268a-268f are arranged horizontally (the direction of arrow A) at two rows. For this reason, when attaching the fuel cell stack 260 especially, the adapter plate 152 does not fall, and the effect that said fuel cell stack 260 can be efficiently attached by easy work is acquired.

[0081]In the fuel cell stack 260, the ratio of the form width H5 to the vertical size H6 is set as the abbreviation 3:2. Therefore, to the whole surface of the 2nd end plate 24 the six belleville springs 268a-

268f, It becomes possible a sliding direction and to arrange uniformly horizontally, it can bind tight certainly and the fuel cell stack 260 whole can be held so that planar pressure distribution may become uniform, and it becomes possible to secure effective sealing nature.

[0082]By this 3rd embodiment, the six washer plates 264a-264f are arranged as a planar pressure grant member further again at the outside surface side of the 1st end plate 16. While it is simplified effectively and composition will become very economical by this, the sizes of a thickness direction are reduced and short length-ization of the laminating direction of the fuel cell stack 260 whole is attained easily.

[0083]In that case, in the direction of arrow A, as a belleville springs [268a-268f] center and a washer plates [264a-264f] center carry out abbreviation coincidence, respectively, they are arranged. For this reason, when clamping force is given to the fuel cell stack 260 via the belleville springs 268a-268f, it can prevent effectively that moment load occurs and is effective in the ability to prevent a bend etc. from occurring in said fuel cell stack 260.

[0084]It engages with the head 270a of the tie rod 270, and the spherical washer 274 is formed. Therefore, as shown in drawing 22, when the back up plate 148 curves at the time of the application of pressure of the fuel cell stack 260, The spherical washer 274 absorbs modification of this back up plate 148 effectively, and via the tie rod 270, said fuel cell stack 260 can be certainly bound tight in the direction of arrow A, and it can fix.

[0085]Here, while the flat face 276 contacts the 1st end plate 16, the curving surface 278 is carrying out field contact of the washer plates 264a-264f at said back up plate 148 also at the time of modification of the back up plate 148. For this reason, it becomes possible to maintain effectively the bolting state of the fuel cell stack 260 whole.

[0086]Drawing 23 is a partial section explanatory view of the fuel cell stack 300 concerning a 4th embodiment of this invention.

[0087]It is two rows of upper and lower sides, and the accommodation slot 306 for accommodating a plate-like washer plates [which are planar pressure grant members / 304a-304f] part in the outside surface side of the 1st end plate 302 that constitutes this fuel cell stack 300 estranges a prescribed interval every horizontally, and is established in six places. It is two rows of upper and lower sides, and the accommodation slot 310 which counters the accommodation slot 306 and accommodates selectively the washer plates 304a-304f in the back up plate 308 which counters the 1st end plate 302 and is arranged estranges a prescribed interval every horizontally, and is established in six places. The pressing part 312 which projects in the washer plate 304a-304f side is formed in this accommodation slot 310.

[0088]In the fuel cell stack 300 constituted in this way, the six washer plates 304a-304f are arranged corresponding to the accommodation slots 306 and 310 formed in the 1st end plate 302 and the back up plate 308, respectively, for example. Thereby, the washer plates 304a-304f can be built into a desired position easily and certainly, and the effect that the attachment work nature of the fuel cell stack 300 improves effectively is acquired.

[0089]Drawing 24 is a partial section explanatory view of the fuel cell stack 320 concerning a 5th embodiment of this invention.

[0090]In this fuel cell stack 320, the sphere form pressing part 324 which bulges in the washer plate 304a-304f side from the center section of the accommodation slot 310 is formed in the back up plate 322. Since other composition is the same as that of the fuel cell stack 300 concerning a 4th embodiment, the detailed explanation is omitted.

[0091]Drawing 25 is a partial section explanatory view of the fuel cell stack 340 concerning a 6th embodiment of this invention.

[0092]In this fuel cell stack 340, the accommodation slot 306 of the 1st end plate 302 and the accommodation slot 344 on the identical shape are formed in the back up plate 342. The washer plates 264a-264f are accommodated in these accommodation slots 306 and 344. As for the washer plates 264a-264f, while the flat face 276 is arranged at the 1st end-plate 302 side, the curving surface 278 is arranged corresponding to the back-up-plate 342 side. Since other composition is the same as that of the fuel cell stack 300 concerning a 4th embodiment, the detailed explanation is omitted.

[0093]

[Effect of the Invention] While a unit fuel cell is constituted from a fuel cell stack concerning this invention by oblong shape, The force means which pressurizes said unit fuel cell in a laminating direction equips the transverse direction with n belleville springs arranged at one row, and where the size of the height direction of a fuel cell stack is effectively made low, planar pressure distribution of the whole unit fuel cell surface can be made uniform. Thereby, while maintaining power generation performance highly, it becomes possible to obtain certainly the oblong-shaped fuel cell stack excellent in seal performance.

[0094] In the fuel cell stack concerning this invention, while the power generation surface of a unit fuel cell is constituted by oblong shape, corresponding to the shape of this power generation surface, n belleville springs are arranged in a transverse direction at one row. For this reason, uniform clamping force can be given all over a power generation surface, and it becomes possible to aim at improvement in power generation performance.

[0095] By the fuel cell stack concerning this invention, while a unit fuel cell is constituted by oblong shape, the force means which counters a planar pressure grant member and is arranged equips the transverse direction with six or more belleville springs arranged at two rows further again. Therefore, while the attachment work nature of a fuel cell stack improves, it becomes possible to make uniform planar pressure distribution of the whole unit fuel cell surface.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the fuel cell stack by which the end plate was allocated in the laminating direction both ends of said unit fuel cell cell while two or more unit fuel cell cells which comprise an anode lateral electrode and a cathode lateral electrode on both sides of solid polyelectrolyte membrane are horizontally laminated via a separator.

[Translation done.]

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PRIOR ART

[Description of the Prior Art]For example, the polymer electrolyte fuel cell is constituted by pinching with a separator the unit fuel cell cell constituted by the both sides of the electrolyte membrane which consists of a polymers ion-exchange membrane (cation exchange membrane) by an opposite *(ing) an anode lateral electrode and a cathode lateral electrode, respectively. This polymer electrolyte fuel cell is usually used as a fuel cell stack, when only a predetermined number laminates a unit fuel cell cell and a separator.

[0003]In this kind of fuel cell stack, on a catalyzer electrode, the fuel gas supplied to the anode lateral electrode, for example, hydrogen containing gas, is hydrogen-ion-ized, and it moves to the cathode lateral electrode side via the electrolyte membrane humidified moderately. The electron produced in the meantime is taken out by the external circuit, and is used as electrical energy of a direct current. Since oxidant gas, for example, oxygen containing gas, or air is supplied, in this cathode lateral electrode, said hydrogen ion, said electron, and oxygen gas react to a cathode lateral electrode, and water is generated.

[0004]By the way, if the contact resistance in a fuel cell stack increases, an internal resistance loss will increase and terminal voltage will fall. For this reason, it is necessary to give desired clamping force to each unit fuel cell cell laminated so that the planar pressure given to an electrode surface (power generation surface) may become uniform, in order to reduce contact resistance.

[0005]Then, for example, as indicated by the U.S. Pat. No. 5,484,666 gazette, While forming every two-piece a total of four crevices in a sliding direction and a horizontal direction and arranging a belleville spring to this crevice at one side of the end plate arranged to the both ends of the fuel cell stack, The fuel cell stack constituted so that said whole fuel cell stack might be bound tight and it might fix is known by inserting in a tie rod over both end plates in said belleville spring, and screwing a nut in the end of said tie rod.

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EFFECT OF THE INVENTION

[Effect of the Invention]While a unit fuel cell cell is constituted from a fuel cell stack concerning this invention by oblong shape, The force means which pressurizes said unit fuel cell cell in a laminating direction equips the transverse direction with n belleville springs arranged at one row, and where the size of the height direction of a fuel cell stack is effectively made low, planar pressure distribution of the whole unit fuel cell cell surface can be made uniform. Thereby, while maintaining power generation performance highly, it becomes possible to obtain certainly the oblong-shaped fuel cell stack excellent in seal performance.

[0094]In the fuel cell stack concerning this invention, while the power generation surface of a unit fuel cell cell is constituted by oblong shape, corresponding to the shape of this power generation surface, n belleville springs are arranged in a transverse direction at one row. For this reason, uniform clamping force can be given all over a power generation surface, and it becomes possible to aim at improvement in power generation performance.

[0095]By the fuel cell stack concerning this invention, while a unit fuel cell cell is constituted by oblong shape, the force means which counters a planar pressure grant member and is arranged equips the transverse direction with six or more belleville springs arranged at two rows further again. Therefore, while the attachment work nature of a fuel cell stack improves, it becomes possible to make uniform planar pressure distribution of the whole unit fuel cell cell surface.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, in the above-mentioned conventional technology, since it formed two crevices in the end plate at a time at the upper and lower sides and right and left, respectively and the belleville spring is arranged, as the whole fuel cell stack, the size of the height direction is equivalent to a lateral size, or serves as a size beyond it. For this reason, when it is going to carry a fuel cell stack in vehicles etc. especially, the place in which this fuel cell stack can be accommodated will be limited fairly.

[0007]And in the above-mentioned conventional technology, four belleville springs are only arranged to an end plate. Thereby, there is a possibility that uniform planar pressure cannot be given all over the power generation surface of a unit fuel cell cell via a belleville spring.

[0008]This invention solves this kind of problem.

The purpose is providing the fuel cell stack which can give uniform clamping force to the whole unit fuel cell cell laminated while short-length-izing effectively the size of the height direction of the whole fuel cell stack.

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MEANS

[Means for Solving the Problem]In a fuel cell stack concerning claim 1 of this invention, while two or more unit fuel cell cells are laminated horizontally, this unit fuel cell cell is constituted by oblong rectangular form, and that form width is set up more than the twice of that vertical size. For this reason, when a size of a height direction of the whole fuel cell stack is short-length-ized effectively, for example, being carried in vehicles etc., while being able to utilize effectively a space by the side of the upper part of said fuel cell stack, it becomes possible to accommodate this fuel cell stack in an under floor of a car body, etc. easily.

[0010]While a fluid enclosure member for planar pressure grant is provided in one end-plate side of a fuel cell stack, a force means which equipped a transverse direction with two or more belleville springs arranged at one row is arranged at the end-plate side of another side. Thereby, uniform planar pressure is certainly given to the whole unit fuel cell cell laminated under a pressing action of a force means. And two or more belleville springs are arranged at one row, a belleville spring can be uniformly arranged along with shape of a unit fuel cell cell, and it becomes possible to give clamping force suitably and firmly to said unit fuel cell cell.

[0011]In a fuel cell stack concerning claim 2, a ratio of form width of a unit fuel cell cell to a vertical size is set as an integer ratio of abbreviated n:1. For this reason, while making height of the whole fuel cell stack still lower, two or more belleville springs can be uniformly arranged to the whole unit fuel cell cell surface, and it becomes possible to equalize said planar pressure given all over a unit fuel cell cell much more with high precision.

[0012]In a fuel cell stack concerning claim 3, while two or more unit fuel cell cells are laminated horizontally, a power generation surface of this unit fuel cell cell is constituted by oblong rectangular form, and that form width is set up more than the twice of that vertical size. Therefore, uniform planar pressure can be certainly given to each whole power generation surface of a unit fuel cell cell laminated.

[0013]By a fuel cell stack concerning claim 4, a ratio of form width of a power generation surface of a unit fuel cell cell to a vertical size is set as an integer ratio of abbreviated n:1 further again. Thereby, two or more belleville springs can be uniformly arranged to the whole power generation surface surface, and it becomes possible to equalize said planar pressure given all over a power generation surface much more with high precision.

[0014]In a fuel cell stack concerning claim 5, while a unit fuel cell cell is formed in oblong rectangular form, a planar pressure grant member is provided in one end-plate side, and a force means which equips the end-plate side of another side with six or more belleville springs arranged in a transverse direction at two rows is arranged. for this reason -- falling at the time of an assembly, while giving uniform planar pressure to the whole unit fuel cell cell -- etc. -- it does not cause and assembling work of a fuel cell stack is carried out with high precision and efficiently.

[0015]A planar pressure grant member is provided with six or more washer plates arranged in a transverse direction at two rows corresponding to a belleville spring in a fuel cell stack concerning claim 6. Therefore, composition simplifies and it will become economical, and since each belleville spring and

each washer plate counter mutually and are moreover arranged, it becomes possible to prevent moment load from giving certainly and to bind the whole fuel cell stack tight firmly and certainly. By moreover using a washer plate, the thinning of the size of a laminating direction of a unit fuel cell cell which is a thickness direction is carried out, and a laminating direction of the whole fuel cell stack can be short-length-sized effectively.

[0016]By a fuel cell stack concerning claim 7, a ratio of form width of a unit fuel cell cell to a vertical size is set as the abbreviation 3:2 further again. For this reason, especially, two rows of a total of six or more belleville springs can be uniformly arranged to the whole unit fuel cell cell surface in each transverse direction, and said thing [giving planar pressure with high precision and uniformly all over a unit fuel cell cell] becomes possible.

[0017]In a fuel cell stack concerning claim 8, it has a clamping bolt which holds a unit fuel cell cell in one to a laminating direction, and a spherical washer which engages with a head of said clamping bolt. When carrying out application-of-pressure maintenance of the whole fuel cell stack by this in a laminating direction, even if an end plate and the back up plate which support a clamping bolt change, clamping force of a laminating direction can be certainly given to a fuel cell stack under an operation of a spherical washer.

[0018]

[Embodiment of the Invention]Drawing 1 is an outline strabism explanatory view of the fuel cell system 10 incorporating the fuel cell stack concerning a 1st embodiment of this invention, and drawing 2 is a side explanatory view of said fuel cell system 10.

[0019]The fuel cell system 10 is provided with the 1st fuel cell stack 12 and the 2nd fuel cell stack 14 which are mutually arranged in parallel along a horizontal direction (the direction of arrow A). The 2nd electric power extraction terminal 22 which is the 1st electric power extraction terminal 20 and negative electrode which are anodes is formed in the 1st end plate 16 and 18 that constitutes the end part vertical plane by the side of the same of the 1st and 2nd fuel cell stacks 12 and 14.

[0020]The piping mechanism 28 for performing supply and discharge of fuel gas, oxidant gas, and a cooling medium to said 1st and 2nd fuel cell stacks 12 and 14 is included in the 2nd end-plate 24 and 26 side which is an other end vertical plane by the side of the same of the 1st and 2nd fuel cell stacks 12 and 14. The 1st and 2nd fuel cell stacks 12 and 14 are fixed to the attaching plate 31 which constitutes vehicles via the mounting mechanism 30.

[0021]The 1st fuel cell stack 12 is provided with the 1st and 2nd separators 34 and 36 that pinch the unit fuel cell cell 32 and this unit fuel cell cell 32 as shown in drawing 3 and drawing 4, and two or more sets of these are laminated horizontally (the direction of arrow A). A long side direction (the direction of arrow C) directs horizontally, and the 1st fuel cell stack 12 is arranged while it has rectangular parallelepiped shape as a whole and a short side direction (the direction of arrow B) directs in a gravity direction.

[0022]While the unit fuel cell cell 32 has the solid polyelectrolyte membrane 38, and the cathode lateral electrode 40 and the anode lateral electrode 42 which are allocated on both sides of this electrolyte membrane 38, The 1st and 2nd gas diffusion layers 44 and 46 that consist of porosity carbon paper etc. which are porous layers, for example are allocated by said cathode lateral electrode 40 and said anode lateral electrode 42.

[0023]They are formed in the both sides of the unit fuel cell cell 32 by the 1st and 2nd gaskets 48 and 50, and said 1st gasket 48, While it has the big opening 52 for storing the cathode lateral electrode 40 and the 1st gas diffusion layer 44, said 2nd gasket 50 has the big opening 54 for storing the anode lateral electrode 42 and the 2nd gas diffusion layer 46. The unit fuel cell cell 32 and the 1st and 2nd gaskets 48 and 50 are pinched with the 1st and 2nd separators 34 and 36.

[0024]The shorter side 55b directs in a gravity direction, and the 1st separator 34 is arranged while the field 34a which counters the cathode lateral electrode 40, and the field 34b of the opposite hand are set as rectangular form, for example, the long side 55a directs horizontally.

[0025]The oxidizing agent gas inlet 56a for passing the oxidant gas which is oxygen gas or air, and the fuel gas inlet 58a for passing fuel gas, such as hydrogen gas, have long picture rectangular form, and are

established in a sliding direction at the both-ends edge upper part side by the side of the shorter side 55b of the 1st separator 34. It has long picture rectangular form in a sliding direction, and the oxidant gas exit 56b and the fuel gas outlet 58b are established in it at the both-ends edge lower part side by the side of the shorter side 55b of the 1st separator 34 so that it may become the oxidizing agent gas inlet 56a and the fuel gas inlet 58a, and a diagonal position.

[0026]While the four cooling-medium entrances [long picture / the direction of arrow C] 60a-60d are established in the lower end part of the long side 55a of the 1st separator 34, the four cooling-medium exits [long picture / the direction of arrow C] 60e-60h are similarly established in the upper part by the side of the long side 55a of this 1st separator 34. Cooling media, such as pure water, ethylene glycol, and oil, are supplied to the cooling-medium entrances 60a-60d.

[0027]The ten 1st oxidant gas passage grooves 62 it is open for free passage to the oxidizing agent gas inlet 56a and which became independent, respectively are established in the field 34a of the 1st separator 34 toward a gravity direction, moving in a zigzag direction horizontally. The 1st oxidant gas passage groove 62 joins the five 2nd oxidant gas passage grooves 65, and said 2nd oxidant gas passage groove 65 opens it for free passage to the oxidant gas exit 56b. The pore 63 for tie rod insertion is formed in six places at the 1st separator 34.

[0028]The 2nd separator 36 is formed in rectangular form, and to the both-ends edge upper part side by the side of the shorter side 64b of this 2nd separator 36. While penetration formation of the oxidizing agent gas inlet 66a and the fuel gas inlet 68a is carried out, penetration formation of the oxidant gas exit 66b and the fuel gas outlet 68b is carried out at the both-ends edge lower part side so that it may become said oxidizing agent gas inlet 66a and said fuel gas inlet 68a, and a diagonal position.

[0029]Penetration formation of the four cooling-medium entrances [long picture / the direction of arrow C] 70a-70d is carried out at the lower part by the side of the long side 64a of the 2nd separator 36, and penetration formation of the cooling-medium exits 70e-70h is similarly carried out in the direction of arrow C in the upper part by the side of this long side 64a at a long picture.

[0030]As shown in drawing 5, it is open for free passage to the fuel gas inlet 68a, and the ten 1st fuel gas flow route slots 72 are formed in the field 36a of the 2nd separator 36. This 1st fuel gas flow route slot 72 is formed toward a gravity direction, moving in a zigzag direction horizontally, the five 2nd fuel gas flow route slots 73 are joined, and said 2nd fuel gas flow route slot 73 is open for free passage to the fuel gas outlet 68b.

[0031]As shown in drawing 6, the cooling-medium channels 74a-74d which are individually open for free passage, respectively are established in the field 36b of an opposite hand toward a gravity direction at the cooling-medium entrances 70a-70d and the cooling-medium exits 70e-70h in the field 36a of the 2nd separator 36. While the cooling-medium channels 74a-74d are provided with the 1st passage groove 76a and 76b of nine each which is open for free passage to the cooling-medium entrances 70a-70d and the cooling-medium exits 70e-70h, Between said 1st passage groove 76a and 76b, mutually, in parallel with a gravity direction, the 2nd two passage grooves 78 estrange a prescribed interval every, and are provided, respectively. The pore 63 for tie rod insertion is formed in six places like [the 2nd separator 36] the 1st separator 34.

[0032]As shown in drawing 7, the tag block 80 and the 1st electric conduction plate 82 which are terminal plates are allocated in the laminating direction both ends of the unit fuel cell cell 32 to which only the predetermined number was laminated. While the 1st end plate 16 is laminated via the electric insulating plate 84 by the tag block 80, this tag block 80 is equipped with the 1st electric power extraction terminal 20.

[0033]As shown in drawing 8, the 1st electric power extraction terminal 20 provides the byway thread parts 88a and 88b in the both ends of the cylindrical major diameter 86. This thread part 88a is projected in the oxidizing agent gas inlet 56a of the 1st separator 34 through the pore 90 formed in the tag block 80, and the nut member 92 is screwed on said thread part 88a. In order to raise the sealing nature between the tag blocks 80 in the shoulder of the major diameter 86, while the sealing member 94 is infixed in it, the insulating ring 98 is infixed between the periphery of said major diameter 86, and the pore 96 formed in the 1st end plate 16.

[0034]As shown in drawing 9, the 1st electric conduction plate 82, It is mostly set to the 2nd separator 36 at identical shape, i.e., rectangular form, and the oxidizing agent gas inlet 100a, the fuel gas inlet 102a and the oxidant gas exit 100b, and the fuel gas outlet 102b are mutually established in the both-ends edge by the side of a shorter side in the diagonal position. While the four cooling-medium entrances 104a-104d and cooling-medium exits 104e-104h are established in the long side back lower part and the upper part of the 1st electric conduction plate 82, respectively, the pore 63 for tie rod insertion is formed in six places.

[0035]the 1st electric conduction plate 82 -- the 1st fuel cell stack 12 bottom -- and the 1st connection plate part 106 which approaches the 2nd fuel cell stack 14 and extends is formed. It projects in the 1st connection plate part 106 caudad, the two bolt parts 108a and 108b are formed in it, and these bolt parts 108a and 108b and the 1st electric conduction plate 82 comprise material which has conductivity, for example, SUS, copper, etc. As shown in drawing 7, the 2nd end plate 24 is laminated by the 1st electric conduction plate 82 via the electric insulating plate 110, the cover plate 112, and the sealing member 114.

[0036]As shown in drawing 10 and drawing 11, the 2nd end plate 24 is constituted by rectangular form, and to the both-ends edge upper part side by the side of the shorter side. While penetration formation of the oxidizing agent gas inlet 120a and the fuel gas inlet 122a is carried out, it is provided in the both-ends edge lower part side by the side of the shorter side so that the oxidant gas exit 120b and the fuel gas outlet 122b may become said oxidizing agent gas inlet 120a and said fuel gas inlet 122a, and a diagonal position.

[0037]In the field 24a inside the 2nd end plate 24. It is a long picture horizontally, and the 1st cooling-medium passage grooves 124a-124d which are open for free passage at the cooling-medium entrances 70a-70d of the 2nd separator 36, and the 2nd cooling-medium passage grooves 124e-124h which are open for free passage to the cooling-medium exits 70e-70h of said 2nd separator 36 have the predetermined depth, and are formed. The 1st cooling-medium passage grooves 124a-124d are open for free passage at the end of the 1st 12 slots 126a, respectively. Two join at a time, respectively, the 2nd slot 126b is formed, every two of said 2nd slot 126b join the 3rd slot 126c, respectively, and the 1st slot 126a is open for free passage to the single cooling-medium feed hopper 128, after extending up in parallel mutually.

[0038]Similarly, it is open for free passage to the 1st 12 slots 130a, respectively, said 1st slot 130a extends in perpendicular down, and the 2nd cooling-medium passage grooves 124e-124h join the 2nd slot 130b two [at a time]. The 2nd slot 130b joins the 3rd slot 130c two [at a time], and is open for free passage to the single cooling-medium outlet 132. As shown in drawing 10, the supply line 134 and the exhaust pipe way 136 are connected with the cooling-medium feed hopper 128 and the cooling-medium outlet 132, and this supply line 134 and this exhaust pipe way 136 have projected only predetermined length outside the 1st fuel cell stack 12 to them at the way. The pore 63 for tie rod insertion is formed in six places at the 2nd end plate 24 (refer to drawing 11).

[0039]As shown in drawing 7, via the clamping mechanism 140, the 1st fuel cell stack 12 is bound tight to a laminating direction (the direction of arrow A) in one, and is fixed to it. The clamping mechanism 140 is provided with the following.

The fluid chamber 142 provided in the outside surface side of the 1st end plate 16.

The incompressible fluid 144 for planar pressure grant enclosed in this fluid chamber 142, for example, a silicone oil

Force means 145.

This force means 145 is formed in the outside surface side of the 2nd end plate 24, and in order to press said 2nd end plate 24 to the 1st end-plate 16 side, it is provided with two or more and the three belleville springs 146a-146c which estrange a prescribed interval every horizontally and are arranged at one row.

[0040]The 1st end plate 16 is countered on both sides of the fluid chamber 142, the back up plate 148 is allocated, and the fluid enclosure member for planar pressure grant which formed the fluid chamber 142 with the sheet metal 150 of this back up plate 148, aluminum, or a stainless steel is constituted. The belleville springs 146a-146c are supported by the adapter plate 152 while estranging them abbreviation

regular intervals every and arranging them in the field of the 2nd end plate 24. The 1st fuel cell stack 12 is penetrated from the adapter plate 152, and the six tie rods 154 are inserted in the back up plate 148. By thrusting the nut 156 into the end of the tie rod 154, the 1st fuel cell stack 12 is held in one.

[0041]As shown in drawing 12, while the 1st fuel cell stack 12 (namely, unit fuel cell cell 32) is constituted by oblong rectangular form, the form width H1 is set up more than the twice of the vertical size H2.

[0042]a 1st embodiment -- the ratio of the form width H1 to the vertical size H2 -- abbreviated n(n is two or more integers):1 -- for example, -- abbreviated -- it is set as the integer ratio of 3:1. In order to give uniform planar pressure all over each unit fuel cell cell 32, to the 1st fuel cell stack 12, the three belleville springs 146a-146c estrange regular intervals every corresponding to the ratio of the form width H1 to the vertical size H2, and it is arranged horizontally (the direction of arrow C). If it puts in another way, the belleville springs 164a-164c of the number corresponding to the ratio can be uniformly arranged to the whole surface of the unit fuel cell cell 32 by setting the ratio of the form width H1 of the unit fuel cell cell 32 to the vertical size H2 as an integer ratio.

[0043]As shown in drawing 2 and drawing 13, the mounting mechanism 30 is provided with the following.

The bracket parts 160a and 160b provided in the lower part side of the 1st end plate 16 in one.

The mount brackets 162a and 162b screwed to the lower part side of the 2nd end plate 24.

While the long picture long holes 164a and 164b are formed in the laminating direction (the direction of arrow A) of the 1st fuel cell stack 12 at the bracket parts 160a and 160b, the pores 166a and 166b are formed in the mount brackets 162a and 162b.

[0044]The rubber mount 168 is arranged at the long holes 164a and 164b and the pores 166a and 166b, respectively. The nut 174 is screwed in this thread part 170a, while the color 172 is arranged at said thread part 170a to which the thread parts 170a and 170b are formed up and down, and the rubber mount 168 projects in the upper part and this color 172 is inserted in the long holes 164a and 164b from here. In the mount bracket 162a and b [162] side, the thread part 170a of the rubber mount 168 is inserted in the pores 166a and 166b, and the nut 174 is screwed in the tip part. The thread part 170b which projects in the lower part side of the rubber mount 168 fixes the 1st fuel cell stack 12 to vehicles etc. by being inserted in the attaching plate 31 and screwing the nut 176.

[0045]As shown in drawing 14, the 2nd fuel cell stack 14, While being constituted symmetrically [the 1st fuel cell stack 12 mentioned above], the cathode lateral electrode 40 and the anode lateral electrode 42 are arranged to the electrolyte membrane 38 at the reverse side, and the 2nd electric power extraction terminal 22 which is a negative electrode is formed in the 1st end-plate 18 side (refer to drawing 15). The 2nd fuel cell stack 14 is fundamentally constituted like the 1st fuel cell stack 12, gives the same reference mark to the same component, and omits the detailed explanation.

[0046]As shown in drawing 16, the 2nd fuel cell stack 14, The 2nd connection plate part 182 close to the 1st connection plate part 106 of the 1st electric conduction plate 82 which is provided with the 2nd electric conduction plate 180, and extends on this 2nd electric conduction plate 180 at said 2nd fuel cell stack 14 bottom, and is provided in the 1st fuel cell stack 12 is formed. The bolt parts 108a and 108b of a couple, and 184a and 184b are provided in the 1st and 2nd connection plate parts 106 and 182, respectively.

[0047]The flexible connection body 186a and 186b, for example, stranded wires, is connected to the bolt parts 108a and 184a and the bolt parts 108b and 184b, respectively. The stranded wires 186a and 186b are constituted by twisting the lead of much thin line state to mesh texture, and are covered with the rubber covers 188a and 188b, respectively.

[0048]As shown in drawing 14, to the 2nd end plate 24 and 26 that constitutes the 1st and 2nd fuel cell stacks 12 and 14. The fuel gas inlet 122a and the oxidant gas exit 120b are arranged at the position which approaches mutually, respectively, and the piping mechanism 28 is included in this 2nd end plate 24 and 26.

[0049]As shown in drawing 1 and drawing 17, the piping mechanism 28, It has the 1st bracket 190 that covers each fuel gas inlet 122a of the 2nd end plate 24 and 26 that constitutes the 1st and 2nd fuel cell

stacks 12 and 14 installed side by side mutually, and is fixed to said 2nd end plate 24 and 26 in one. The fuel gas supply pipes 192a and 192b which are open for free passage, respectively are formed in each fuel gas inlet 122a, said fuel gas supply pipes 192a and 192b join this 1st bracket 190, and it is open for free passage to the fuel gas feed hopper 194.

[0050]Each oxidant gas exit 120b is covered to the 2nd end plate 24 and 26, and the 2nd bracket 196 is fixed to it. The tip part of the oxidant gas exhaust pipes 198a and 198b which are formed in this 2nd bracket 196 and are open for free passage to the oxidant gas exit 120b, respectively is open for free passage in one to the oxidant gas outlet 200.

[0051]Each oxidizing agent gas inlet 120a and fuel gas outlet 122b are covered to the 2nd end plate 24 and 26, and the 3rd and 4th brackets 202 and 204 are fixed to it. While the both ends of the oxidant gas feed pipe 206 which is open for free passage to the oxidizing agent gas inlet 120a are open for free passage to the 3rd and 4th brackets 202 and 204, the oxidant gas feed hopper 208 is established in the way of this oxidant gas feed pipe 206. To the 3rd and 4th brackets 202 and 204, the both ends of the fuel gas exhaust pipe 210 which is open for free passage to the fuel gas outlet 122b are open for free passage, and the fuel gas outlet 212 is formed in the way of this fuel gas exhaust pipe 210.

[0052]The both ends of the cooling medium supplying pipe 214 are connected with each supply line 134 established in the 2nd end plate 24 and 26, and the cooling-medium feed hopper 216 is established in this cooling medium supplying pipe 214. While the cooling medium discharge pipe 218 is connected with each exhaust pipe way 136 established in the 2nd end plate 24 and 26, the cooling-medium outlet 220 is formed in this cooling medium discharge pipe 218.

[0053]Operation of the fuel cell system 10 constituted in this way is explained below.

[0054]As shown in drawing 1, while fuel gas (for example, gas containing the hydrogen which reformed hydrocarbon) is supplied to the fuel cell system 10 from the fuel gas feed hopper 194, air or oxygen gas (only henceforth air) is supplied to the oxidant gas feed hopper 208 as oxidant gas. A cooling medium is supplied to the cooling-medium feed hopper 216.

[0055]The fuel gas supplied to the fuel gas feed hopper 194, It is sent to each fuel gas inlet 122a of the 2nd end plate 24 and 26 that constitutes the 1st and 2nd fuel cell stacks 12 and 14 through the fuel gas supply pipes 192a and 192b, and is further introduced into the 1st fuel gas flow route slot 72 from each fuel gas inlet 68a of the 2nd separator 36. As shown in drawing 5, the fuel gas supplied to the 1st fuel gas flow route slot 72 moves to a gravity direction, moving in a zigzag direction horizontally along the field 36a of the 2nd separator 36.

[0056]In that case, hydrogen gas in fuel gas is supplied to the anode lateral electrode 42 of the unit fuel cell 32 through the 2nd gas diffusion layer 46. And while intact fuel gas moves along the 1st fuel gas flow route slot 72 and the anode lateral electrode 42 is supplied, intact fuel gas is discharged from the fuel gas outlet 68b via the 2nd fuel gas flow route slot 73. This intact fuel gas is introduced into the fuel gas exhaust pipe 210 through each fuel gas outlet 122b of the 2nd end plate 24 and 26, and is discharged from the fuel cell system 10 via the fuel gas outlet 212.

[0057]On the other hand, the air supplied to the oxidant gas feed hopper 208, It is sent to each oxidizing agent gas inlet 120a established in the 2nd end plate 24 and 26 via the oxidant gas feed pipe 206, and the oxidizing agent gas inlet 56a of the 1st separator 34 further incorporated in the 1st and 2nd fuel cell stacks 12 and 14 is supplied (refer to drawing 3). In the 1st separator 34, the air supplied to the oxidizing agent gas inlet 56a is introduced into the 1st oxidant gas passage groove 62 within the field 34a, and it moves to a gravity direction, moving in a zigzag direction horizontally along this 1st oxidant gas passage groove 62.

[0058]While the oxygen gas in the air is supplied to the cathode lateral electrode 40 from the 1st gas diffusion layer 44 in that case, intact air is discharged from the oxidant gas exit 56b via the 2nd oxidant gas passage groove 65. The air discharged by this oxidant gas exit 56b is discharged from the oxidant gas outlet 200 via the oxidant gas exhaust pipes 198a and 198b from the oxidant gas exit 120b established in the 2nd end plate 24 and 26 (refer to drawing 1).

[0059]By this, power generation will be performed by the 1st and 2nd fuel cell stacks 12 and 14, and electric power will be supplied to the load connected between the 1st and 2nd electric power extraction

terminals 20 and 22 in which the characteristics differ, respectively, for example, the motor which is not illustrated.

[0060]The inside of the 1st and 2nd fuel cell stacks 12 and 14 is effectively cooled by a cooling medium. That is, the cooling medium supplied to the cooling-medium feed hopper 216 is introduced into the supply line 134 established in the 2nd end plate 24 and 26 from the cooling medium supplying pipe 214. As shown in drawing 11, this cooling medium is introduced into the cooling-medium feed hopper 128 of the 2nd end plate 24 and 26, and is sent to the 1st cooling-medium passage grooves 124a-124d through the 1st slot 126a from two or more 2nd slots 126b.

[0061]The cooling medium introduced into the 1st cooling-medium passage grooves 124a-124d, It is introduced into the cooling-medium entrances 70a-70d formed in the lower part side of the 2nd separator 36, and as shown in drawing 6, it moves toward the upper part along the cooling-medium channels 74a-74d which are open for free passage at said cooling-medium entrances 70a-70d from a lower part. The cooling medium which cooled each unit fuel cell cell 32 through the cooling-medium channels 74a-74d is introduced into the 2nd cooling-medium passage grooves 124e-124h of the 2nd end plate 24 and 26 through the cooling-medium exits 70e-70h (refer to drawing 11).

[0062]The cooling medium introduced into these 2nd cooling-medium passage grooves 124e-124h is sent to the cooling-medium outlet 132 via the 2nd slot 130b from the 1st slot 130a, and is discharged from the cooling-medium outlet 220 through the cooling medium discharge pipe 218 from the exhaust pipe way 136.

[0063]in this case, a 1st embodiment shows to drawing 12 -- as -- the ratio of the form width H1 of the 1st fuel cell stack 12 (namely, unit fuel cell cell 32), and the vertical size H2 -- abbreviated -- it is set as 3:1. And the fluid chamber 142 by which the clamping mechanism 140 is formed in the outside surface side of the 1st end plate 16 in order to give planar pressure to a laminating direction to the 1st fuel cell stack 12, It was provided in the outside surface side of the 2nd end plate 24, and has the three belleville springs 146a-146c arranged in a transverse direction at one row corresponding to the aspect ratio of the 1st fuel cell stack 12.

[0064]Thus, in a 1st embodiment, since the belleville springs 146a-146c are set up corresponding to the aspect ratio of the unit fuel cell cell 32, the planar pressure distribution in the 1st fuel cell stack 12 becomes uniform. Thereby, while raising power generation performance effectively, the leakage of fuel gas or oxidant gas is prevented, and the effect that effective sealing nature is securable is acquired.

[0065]And the ratio of the form width H1 of the unit fuel cell cell 32 to the vertical size H2 is set to the integer ratio 3:1, for example, abbreviation. Therefore, if the belleville springs 164a-164c of the number corresponding to the integer ratio are used, said belleville springs 164a-164c can be uniformly arranged to the whole surface of the unit fuel cell cell 32. The oxidant gas communicating path which includes by this the oxidizing agent gas inlet 56a and the oxidant gas exit 56b which were especially established in the both ends of the unit fuel cell cell 32, It becomes possible to give uniform clamping force to the circumference of a fuel gas communicating path including the fuel gas inlet 68a and the fuel gas outlet 68b, and there is an advantage that the sealing nature of oxidant gas and fuel gas is maintainable with high precision.

[0066]The 1st fuel cell stack 12 can be constituted oblong, and it becomes possible to set up fairly the size of the height direction of said 1st fuel cell stack 12 low. Therefore, the fuel cell system 10 has desired electromotive force, can reduce the sizes of a height direction substantially, and has the advantage of becoming possible to use it effectively as the fuel cell system 10 for mount especially.

[0067]While the 1st and 2nd fuel gas flow route slots 72 and 73 lie in a zigzag line horizontally and being provided in one field 36a toward a gravity direction in the 2nd separator 36, The 1st passage groove 76a and 76b and the 2nd passage groove 78 which constitute the cooling-medium channels 74a-74d are established in the field 36b of said 2nd separator 36 toward the gravity direction.

[0068]Thus, in the 2nd separator 36, the 1st and 2nd fuel gas flow route slots 72 and 73 and the 1st and 2nd passage grooves 76a, 76b, and 78 are formed so that it may intersect perpendicularly mutually, and the flexural rigidity of said 2nd separator 36 very thing improves effectively. It becomes possible to carry out the thinning of the thickness of the 2nd separator 36 effectively by this, and it becomes

possible to short-length-size easily the size of the laminating direction of the 1st fuel cell stack 12 whole. [0069]Although a 1st embodiment explained the 1st and 2nd fuel cell stacks 12 and 14 using the fuel cell system 10 which the laminating direction was made to arrange in parallel, the same effect is acquired also when using only the 1st fuel cell stack 12.

[0070]Drawing 18 is a transverse-plane explanatory view of the fuel cell stack 240 concerning a 2nd embodiment of this invention. The same reference mark is given to the same component as the 1st fuel cell stack 12 concerning a 1st embodiment, and the detailed explanation is omitted. Also in the fuel cell stack 260 concerning a 3rd embodiment described below, it is the same.

[0071]In this fuel cell stack 240, the cathode lateral electrode 40 and the anode lateral electrode 42 which constitute the power generation surface of the unit fuel cell cell 32 have oblong rectangular form, and that form width H3 is set up more than the twice of that vertical size H4. a 2nd embodiment -- the ratio of the form width H3 to the vertical size H4 -- abbreviated n(n is two or more integers):1 -- for example, -- abbreviated -- it is set as the integer ratio of 3:1.

[0072]Corresponding to the ratio of the form width H3 of a power generation surface to the vertical size H4, in the fuel cell stack 240, the three belleville springs 146a-146c estrange regular intervals every, and are arranged horizontally (the direction of arrow C) at it. That is, the belleville springs 146a-146c of the number corresponding to the ratio can be uniformly arranged to the whole power generation surface surface by setting the ratio of the form width H3 of the power generation surface of the unit fuel cell cell 32 to the vertical size H4 as an integer ratio.

[0073]Thereby, in a 2nd embodiment, it becomes possible to give uniform clamping force all over the power generation surface in the fuel cell stack 240, and the effect that power generation performance can be raised effectively is acquired.

[0074]Drawing 19 is an outline strabism explanatory view of the fuel cell stack 260 concerning a 3rd embodiment of this invention, and drawing 20 is an outline vertical section explanatory view of said fuel cell stack 260.

[0075]Via the clamping mechanism 262, the fuel cell stack 260 is bound tight to a laminating direction in one, and is fixed to it. This clamping mechanism 262 is provided with the following.

Six or more pieces, the six washer plates 264a-264f which are the planar pressure grant members arranged between the 1st end plate 16 and the back up plate 148.

The force means 266 provided in the outside surface side of the 2nd end plate 24.

[0076]The curving surface 278 which is a surface of a sphere or a circular face is established in the side in contact with the back up plate 148, and the washer plates 264a-264f are set up in the shape of an approximate circle board as a whole, while establishing the flat face 276 in the side which touches the 1st end plate 16. The washer plates 264a-264f are horizontally estranged a prescribed interval every to the 1st end-plate 16 side, and are arranged at two rows of upper and lower sides.

[0077]The force means 266 is provided with six or more pieces and the six belleville springs 268a-268f which estrange a prescribed interval every horizontally and are arranged at two rows of upper and lower sides, in order to be provided in the outside surface side of the 2nd end plate 24 and to press this 2nd end plate 24 to the 1st end-plate 16 side. The belleville springs 268a-268c are set as the position which goes to the upper part side of the 2nd end plate 24 horizontally, and is arranged, and is abbreviated-in agreement in the washer plates 264a-264c and the direction of arrow A. the belleville springs 268d-268f -- the lower part side of the 2nd end plate 24 -- and it is arranged corresponding to the position which is abbreviated-in agreement in the washer plates 264d-264f and the direction of arrow A.

[0078]The fuel cell stack 260 is penetrated from the back up plate 148, and the six tie rods (clamping bolt) 270 are inserted in the adapter plate 152. As shown in drawing 20, while the nut 272 is thrust into the end of the tie rod 270, the spherical washer 274 is infixed between the head 270a of said tie rod 270, and the back up plate 148.

[0079]As shown in drawing 21, while the fuel cell stack 260 is formed in oblong rectangular form, the ratio of the form width H5 and the vertical size H6 is set as the abbreviation 3:2.

[0080]According to a 3rd embodiment constituted in this way, it estranges regular intervals every

horizontally [are two rows of upper and lower sides, and] in the field of the 2nd end plate 24, and the six belleville springs 268a-268f are arranged horizontally (the direction of arrow A) at two rows. For this reason, when attaching the fuel cell stack 260 especially, the adapter plate 152 does not fall, and the effect that said fuel cell stack 260 can be efficiently attached by easy work is acquired.

[0081]In the fuel cell stack 260, the ratio of the form width H5 to the vertical size H6 is set as the abbreviation 3:2. Therefore, to the whole surface of the 2nd end plate 24 the six belleville springs 268a-268f, It becomes possible a sliding direction and to arrange uniformly horizontally, it can bind tight certainly and the fuel cell stack 260 whole can be held so that planar pressure distribution may become uniform, and it becomes possible to secure effective sealing nature.

[0082]By this 3rd embodiment, the six washer plates 264a-264f are arranged as a planar pressure grant member further again at the outside surface side of the 1st end plate 16. While it is simplified effectively and composition will become very economical by this, the sizes of a thickness direction are reduced and short length-ization of the laminating direction of the fuel cell stack 260 whole is attained easily.

[0083]In that case, in the direction of arrow A, as a belleville springs [268a-268f] center and a washer plates [264a-264f] center carry out abbreviation coincidence, respectively, they are arranged. For this reason, when clamping force is given to the fuel cell stack 260 via the belleville springs 268a-268f, it can prevent effectively that moment load occurs and is effective in the ability to prevent a bend etc. from occurring in said fuel cell stack 260.

[0084]It engages with the head 270a of the tie rod 270, and the spherical washer 274 is formed. Therefore, as shown in drawing 22, when the back up plate 148 curves at the time of the application of pressure of the fuel cell stack 260, The spherical washer 274 absorbs modification of this back up plate 148 effectively, and via the tie rod 270, said fuel cell stack 260 can be certainly bound tight in the direction of arrow A, and it can fix.

[0085]Here, while the flat face 276 contacts the 1st end plate 16, the curving surface 278 is carrying out field contact of the washer plates 264a-264f at said back up plate 148 also at the time of modification of the back up plate 148. For this reason, it becomes possible to maintain effectively the bolting state of the fuel cell stack 260 whole.

[0086]Drawing 23 is a partial section explanatory view of the fuel cell stack 300 concerning a 4th embodiment of this invention.

[0087]It is two rows of upper and lower sides, and the accommodation slot 306 for accommodating a plate-like washer plates [which are planar pressure grant members / 304a-304f] part in the outside surface side of the 1st end plate 302 that constitutes this fuel cell stack 300 estranges a prescribed interval every horizontally, and is established in six places. It is two rows of upper and lower sides, and the accommodation slot 310 which counters the accommodation slot 306 and accommodates selectively the washer plates 304a-304f in the back up plate 308 which counters the 1st end plate 302 and is arranged estranges a prescribed interval every horizontally, and is established in six places. The pressing part 312 which projects in the washer plate 304a-304f side is formed in this accommodation slot 310.

[0088]In the fuel cell stack 300 constituted in this way, the six washer plates 304a-304f are arranged corresponding to the accommodation slots 306 and 310 formed in the 1st end plate 302 and the back up plate 308, respectively, for example. Thereby, the washer plates 304a-304f can be built into a desired position easily and certainly, and the effect that the attachment work nature of the fuel cell stack 300 improves effectively is acquired.

[0089]Drawing 24 is a partial section explanatory view of the fuel cell stack 320 concerning a 5th embodiment of this invention.

[0090]In this fuel cell stack 320, the sphere form pressing part 324 which bulges in the washer plate 304a-304f side from the center section of the accommodation slot 310 is formed in the back up plate 322. Since other composition is the same as that of the fuel cell stack 300 concerning a 4th embodiment, the detailed explanation is omitted.

[0091]Drawing 25 is a partial section explanatory view of the fuel cell stack 340 concerning a 6th embodiment of this invention.

[0092]In this fuel cell stack 340, the accommodation slot 306 of the 1st end plate 302 and the

accommodation slot 344 on the identical shape are formed in the back up plate 342. The washer plates 264a-264f are accommodated in these accommodation slots 306 and 344. As for the washer plates 264a-264f, while the flat face 276 is arranged at the 1st end-plate 302 side, the curving surface 278 is arranged corresponding to the back-up-plate 342 side. Since other composition is the same as that of the fuel cell stack 300 concerning a 4th embodiment, the detailed explanation is omitted.

[Translation done.]

*** NOTICES ***

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is an outline strabism explanatory view of the fuel cell system incorporating the fuel cell stack concerning a 1st embodiment of this invention.

[Drawing 2] It is a side explanatory view of said fuel cell system.

[Drawing 3] It is an important section exploded perspective view of said fuel cell stack.

[Drawing 4] It is an important section vertical section explanatory view of said fuel cell stack.

[Drawing 5] It is a transverse-plane explanatory view of one field of the 2nd separator that constitutes said fuel cell stack.

[Drawing 6] It is a transverse-plane explanatory view of the field of another side of said 2nd separator.

[Drawing 7] It is an outline vertical section explanatory view of said fuel cell stack.

[Drawing 8] It is an explanatory view showing the connection structure of the electric power extraction terminal which constitutes said fuel cell stack.

[Drawing 9] It is a strabism explanatory view of the electric conduction plate which constitutes said fuel cell stack.

[Drawing 10] It is a channel explanatory view showing the flow of the fluid in said fuel cell stack.

[Drawing 11] It is a transverse-plane explanatory view of the field by the side of the inner direction of the 2nd end plate that constitutes said fuel cell stack.

[Drawing 12] It is a transverse-plane explanatory view of said fuel cell stack.

[Drawing 13] It is a flat-surface explanatory view of said fuel cell stack.

[Drawing 14] It is a transverse-plane explanatory view of said fuel cell system in the state where the piping mechanism was omitted.

[Drawing 15] It is a back explanatory view of said fuel cell system.

[Drawing 16] It is a strabism explanatory view showing said fuel cell system bottom.

[Drawing 17] It is a transverse-plane explanatory view of said fuel cell system.

[Drawing 18] It is a transverse-plane explanatory view of the fuel cell stack concerning a 2nd embodiment of this invention.

[Drawing 19] It is an outline strabism explanatory view of the fuel cell stack concerning a 3rd embodiment of this invention.

[Drawing 20] It is an outline vertical section explanatory view of said fuel cell stack.

[Drawing 21] It is a transverse-plane explanatory view of said fuel cell stack.

[Drawing 22] the pressurization state of said fuel cell stack is shown -- it is a section explanatory view in part.

[Drawing 23] It is a partial section explanatory view of the fuel cell stack concerning a 4th embodiment of this invention.

[Drawing 24] It is a partial section explanatory view of the fuel cell stack concerning a 5th embodiment of this invention.

[Drawing 25] It is a partial section explanatory view of the fuel cell stack concerning a 6th embodiment of this invention.

[Description of Notations]

10 -- Fuel cell system
12, 14, 240, 260, 300, 320, 340 -- Fuel cell stack
16, 18, 24, 26, 302 -- End plate
20, 22 -- Electric power extraction terminal 28 -- Piping mechanism
30 -- Mounting mechanism 32 -- Unit fuel cell cell
34, 36 -- Separator 38 -- Electrolyte membrane
40 -- Cathode lateral electrode 42 -- Anode lateral electrode
56a, 66a, 100a, 120a -- Oxidizing agent gas inlet
56b, 66b, 100b, 120b -- Oxidant gas exit
58a, 68a, 102a, 122a -- Fuel gas inlet
58b, 68b, 102b, 122b -- Fuel gas outlet
60a-60d and 70a-70d and 104a-104d -- Cooling-medium entrance
60e-60h and 70e-70h and 104e-104h -- Cooling-medium exit
62, 65 -- Oxidant gas passage groove 72, 73 -- Fuel gas flow route slot
74a-74d -- Cooling-medium channel 80 -- Tag block
82, 180 -- Electric conduction plate 106, 182 -- Connection plate part
124a-124h -- Cooling-medium passage groove
134 -- Supply line 136 -- Exhaust pipe way
140, 262 -- Clamping mechanism 142 -- Fluid chamber
145, 266 -- Force means
146a-146c and 268a-268f -- Belleville spring
148, 308, 322, 342 -- Back up plate
154, 270 -- Tie rod 160a, 160b -- Bracket part
162a, 162b -- Mount bracket
168 -- Rubber mount 186a, 186b -- Stranded wire
188a, 188b -- Rubber cover
264a-264f and 304a-304f -- Washer plate

[Translation done.]